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FAB 26

NITROSAMINES

SELECTED FROM VOLUME 14

FOOD SCIENCE AND TECHNOLOGY ABSTRACTS

er the direction of:-

mmonwealth Agricultural Bureaux, Farnham Royal, Slough; Gesellschaft fur Information und umentation, Frankfurt am Main; Institute of Food Technologists, Chicago; Centrum voor dbouwpublikaties en Landbouwdocumentatie (Pudoc), Wageningen.

INTRODUCTION

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Titles of the FABs now available are given on the back cover of this booklet. For up-to-date lists of FABs or suggestions for new topics please write to the address on the back cover. New subjects are searched for at least the five most recent volumes of Food Science and Technology Abstracts. Thereafter each FAB is updated monthly. Copies of each months abstracts on any topic may be obtained as indicated on the back cover of this publication. At the end of each volume of up-dating, the abstracts are merged and made available as a separate supplement to the original FAB.

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Copies of all original articles referred to in the abstracts may be bought (or occasionally borrowed) from the International Food Information Service. A form for ordering these is provided at the end of this FAB.

Coverage of the subject has been restricted to that of Food Science and Technolggy Abstracts, which covers over 1200 of the important food journals, patents from 20 countries and books published world-wide. Every effort is made to include all significant references, but editorial discretion is used on the many articles of borderline interest. If the reader particularly needs an exhaustive search of the subject, we will be pleased to provide any other references that we have available. We would, in any case, encourage readers to write or telephone us with any comments or queries that they may have.

H. BROOKES

EDITOR

1

Effect of alcohols on nitrosamine formation.
Kurechi, T.; Kikugawa, K.; Kato, T.
Food and Cosmetics Toxicology 18 (6) 591–595 (1980) [17 ref. En] [Tokyo Coll. of Pharmacy, 1432-1 Horinouchi, Hachioji, Tokyo 192-03, Japan]

Effects of ethanol, methanol, n-propanol, isopropanol, sucrose and several commercial alcoholic drinks (whisky, Japanese sake and wine) on the nitrosation reaction between sodium nitrite and dimethylamine or diethylamine were investigated. The alcohols and alcoholic drinks inhibited the formation of *N*-nitrosodimethylamine or *N*-nitrosodiethylamine from sodium nitrite and the appropriate dialkylamine at pH 3 but enhanced the reaction at pH 5.0. VJG

2

***N*-nitroso compounds from reactions of nitrite with methylamine.**
Obiedzinski, M. W.; Wishnok, J. S.; Tannenbaum, S. R.
Food and Cosmetics Toxicology 18 (6) 585–589 (1980) [22 ref. En] [Meat & Fat Res. Inst., Rackowiecka 36, O2-532 Warsaw, Poland]

The possible formation of potentially carcinogenic or mutagenic nitrosamines from the primary amine methylamine (widely distributed in foods) was investigated. The reactions were carried out at various pHs and in the presence of thiocyanate and formaldehyde. Higher yields of *N*-nitrosodimethylamine were obtained at pH 5 than at pH 2. It is therefore important to consider the contribution of primary amines as well as secondary amines when assessing the significance to humans of in vivo nitrosation of amines. VJG

3

Residual sulfur dioxide in finished malt: colorimetric determination and relation to *N*-nitrosodimethylamine.
Lukes, B.; O'Brien, T. J.; Scanlan, R. A.
Journal of the American Society of Brewing Chemists 38 (4) 146–148 (1980) [9 ref. En] [Great Western Malting Co., Vancouver, Washington 98668, USA]

Residual SO_2 concn. in production malts from direct-fire, fossil fuel kilns in which SO_2 was applied to control *N*-nitrosodimethylamine (NDMA) formation were determined by a modified colorimetric procedure and correlated to malt NDMA content from analysis by gas chromatography-thermal energy analysis. Malt samples containing residual SO_2 at >30 mg/kg had <10 μg/kg of NDMA. Samples with SO_2 residual of <30 mg/kg were correlated to NDMA levels. Detn. of residual SO_2 values can therefore be used as a rapid screening procedure to detect production malts that may contain NDMA at >10 μg/kg. AS

4

Model system studies on N-nitrosamine formation in cured meats: the effect of slice thickness.
Theiler, R. F.; Aspelund, T. G.; Sato, K.; Miller, A. F.
Journal of Food Science 46 (3) 691–693 (1981) [15 ref. En] [Food Chem. Dep., Armour Res. Cent., 15101 N. Scottsdale Road, Scottsdale, Arizona 85260, USA]

A model bacon system has been developed which enables a more reproducible detn. of N-nitrosamines when compared to conventional methods of bacon production. Utilizing this system, the effect of slice thickness and frying time on nitrosopyrrolidine (NP) formation has been demonstrated using brazed fresh skinless pork bellies. Short frying periods (3 min/side) result in higher NP levels for thinner sliced samples and longer frying periods (5 min/side) result in higher NP levels for thicker sliced samples. The level of N-nitrosamine formed is integrally related to slice thickness and frying time and may be explained when 2 factors are considered. i.e. the rate of N-nitrosamine formation and the rate of its volatilization. IFT

5

Investigations on nitrosamines in irradiation-sterilized bacon.
Fiddler, W.; Gates, R. A.; Pensabene, J. W.; Phillips, J. G.; Wierbicki, E.
Journal of Agricultural and Food Chemistry 29 (3) 551–554 (1981) [26 ref. En] [E. Reg. Res. Cent., USDA, Philadelphia, Pennsylvania 19118, USA]

The effect of irradiation sterilization with ^{60}Co (3.0 Mrad at −40°C) on nitrosamine formation and preformed nitrosamines in bacon was determined, and development of a low nitrite, nitrosamine-free irradiated bacon that provides protection against pathogenic microorganisms such as *Clostridium botulinum* was investigated. The data suggest that irradiation sterilization with ^{60}Co reduces residual nitrite in bacon prior to frying, thereby reducing volatile nitrosamines after frying, and destroys preformed volatile nitrosamines, if present, in the bacon prior to irradiation. In bacon prepared with 20 p.p.m. of $NaNO_2$ and 550 p.p.m. of sodium ascorbate, irradiation produces concn. of nitrosamines that are indistinguishable from those in nitrite-free bacon (<1 ng *N*-nitroso-pyrrolidine/g). AS

6

[Effects of amino acid imbalance and ascorbic acid deficiencies on the carcinogenic effect of *N*-nitrosopiperidine (on guinea pigs).]
Sharmanov, T. Sh.; Aidzhanov, M. M.; Kolycheva, N. I.
Voprosy Pitaniya No. 2, 5–10 (1981) [12 ref. Ru, en] [Kazakhskii Filial Inst. Pitaniya AMN SSSR, Alma-Ata, USSR]

7

[Study of carcinogenic *N*-nitroso compounds in food products.]
Bogovskii, P. A.
Voprosy Pitaniya No. 2, 3-5 (1981) [14 ref. Ru] [Inst. Eksperimental'noi i Klinicheskoi Med. Min. Zdravookhraneniya Estonskoi SSR, Tallin, Estonian SSR]

Aspects briefly covered in this review type article include effects of *N*-nitroso compounds (NC), their occurrence, methods for their detn. in foods, their permissible residual concn., and ways to prevent their formation in the human body. RAW

8

Analytical methodology and determination of *N*-nitrosodimethylamine in beer, wort, and malt.
Markl, K. S.; Latimer, R. A.
Journal of the American Society of Brewing Chemists 39 (2) 59-64 (1981) [20 ref. En] [Anheuser-Busch Inc., St. Louis, Missouri 63118, USA]

Analytical methodology for the detn. of *N*-nitrosodimethylamine (NDMA) in beer, wort and malt was developed. The analysis involved the use of an internal standard, direct extraction of beer or wort with dichloromethane, followed by concn. and gas chromatography-thermal energy analyser detn. of NDMA. The NDMA content of malt was calculated from a laboratory wort. Confirmation of NDMA in beer was obtained by chemical ionization MS. The methods developed for the measurement of NDMA in beer, wort and malt were compared with other analytical methods, and found to be faster, more accurate, and more repeatable. AS

9

Rapid method for estimation of *N*-nitrosodimethylamine in malt beverages.
Hotchkiss, J. H.; Havery, D. C.; Fazio, T.
Journal of the Association of Official Analytical Chemists 64 (4) 929-932 (1981) [7 ref. En] [FDA, Div. of Chem. & Physics, Washington, DC 20204, USA]

A rapid and simple column elution method for detn. of *N*-nitrosodimethylamine (NDMA) in malt beverages is described. 25-g samples of malt beverage are taken. *N*-nitrosodipropylamine (NDPA) is added as an internal standard (carcinogen: handle appropriately) and 25 g Celite are stirred into the sample. The resultant mixture is transferred to a 28 mm internal diam. column containing a glass wool plug over a stopcock, and the nitrosamines are eluted with dichloromethane. Eluate is concentrated to 4 ml at 60° in a Kuderna-Danish apparatus and then to 1 ml under N_2 at ambient temp. Aliquots of this concentrate are directly injected onto a GLC column of 10% Carbowax 1540 + 5% KOH on 100-120 mesh Chromosorb WHP with detection by thermal energy analyser. Recoveries of NDMA and NDPA from beer spiked at 5 ng/g were 90.0 and 91.4%, resp. Correlation coeff. between NDMA and NDPA recoveries was 0.56. Analysis of 10 replicates of a single can of beer gave a mean NDMA concn. of 4.28 ng/g, s.d. 0.07; correction for NDPA recovery increased mean content to 4.68 ng/g but also increased s.d. to 0.11. The column elution method was compared with the more laborious direct distillation technique using 20 malt beverages (ales, lagers and malt liquor); contents of NDMA are tabulated both uncorrected and corrected for NDPA recovery. Overall the 2 methods compared favourably, the column elution method results averaging 0.18 ng/g higher. Two samples that were not amenable to the direct distillation technique (stable foam formation) were analysed without difficulty by the column technique. DIH

10

Gas-liquid chromatographic-thermal energy analyzer determination of *N*-nitrosodimethylamine [NDMA] in beer at low parts per billion level.
Sen, N. P.; Seaman, S.
Journal of the Association of Official Analytical Chemists 64 (4) 933-938 (1981) [10 ref. En] [Food Directorate, Food Res. Div., Health Protection Branch, Ottawa, Ontario, Canada K1A 0L2]

The sample is treated with sulphamic acid under acidic conditions followed by alkalinization with dilute KOH, distillation at atmospheric pressure, extraction of NDMA from alkaline aqueous distillate with dichloromethane, concentration of dichloromethane extract by Kuderna-Danish concentrator, and, finally detn. by a GLC-thermal energy analyser technique with *N*-nitrosodipropylamine (NDPA) as an internal standard. The method gave results comparable with 2 other well established methods. Recoveries of added NDMA, *N*-nitrosodiethylamine, and NDPA at levels ranging from 0.08 to 10 ng/ml were 75-112, 86-115, and 85-109%, resp. Five replicate analyses of a beer sample gave a mean NDMA concn. (corrected for recovery) of 2.21 ± 0.08 ng/ml (± s.d.). Minimum detection limit of the method is about 0.1 ng/ml. AS

11

[Hygienic evaluation of *N*-nitrosamines and their transformation products in water.]
Korolev, A. A.; Mikhailovskii, N. Ya.; Il'nitskii, A. P.
Gigiena i Sanitariya No. 8, 11-14 (1980) [9 ref. Ru, en] [I. Moskovskii Med. Inst. im. I. M. Sechenova, Moscow, USSR]

A toxicological study of *N*-nitrosamines (NA) and their transformation products formed naturally or during purification of drinking and waste waters is presented, with reference to their possible pollution of reservoirs. NA were found to be highly stable compounds. They were effectively removed from water by ozonization or by using activated charcoal filters. NA transformation products formed under the influence of chlorine and ozone accumulated to a lesser extent than, and were not as toxic as the NA themselves. RAW

12

[Artefact formation in nitrosamine determination: analysis of *N*-nitrosodimethylamine (NDMA) in beer.] Artefaktbildungen bei der Nitrosaminbestimmung: Zur Analyse von Nitrosodimethylamin (NDMA) in Bier.
Aitzetmüller, K.; Thiele, E.

Zeitschrift für Lebensmittel-Untersuchung und -Forschung 173 (2) 117–120 (1981) [6 ref. De, en]
[NATEC Inst. für Naturwissenschaftlich-tech. Dienste GmbH, Behringstr. 154, D-2000 Hamburg 50, Federal Republic of Germany]

Artefact formation during cleanup of samples for nitrosamine detn. is dicussed. After vacuum steam distillation from alkaline solution, nitrosamines are normally extracted from the distillate under acidic conditions, often with a kieselguhr extraction aid; apparently under these conditions the kieselguhr contains a contaminant that acts as nitrosation agent. Heating the extraction aid at 200–220°C overnight and then storage in a desiccator is recommended as a means of minimizing artefacts, as well as reversal of the order of acidic and basic conditions so that extraction takes place under alkaline conditions. In the case of beer, for which a detailed procedure for detn. of NDMA is given, addition of ascorbic acid to the sample and preheating of the kieselguhr is sufficient to avoid artefactual nitrosation (no distillation stage is necessary so extraction should not be under alkaline conditions to avoid pressure of free amines in extract). DIH

13

An investigation into the possible presence of volatile N-nitrosamines in cooking oils, margarine, and butter.
Sen, N. P.; Seaman, S.
Journal of Agricultural and Food Chemistry 29 (4) 787–789 (1981) [11 ref. En] [Food Res. Div., Health Protection Branch, Ottawa, Canada K1A 0L2]

Following a report of occurrence of volatile nitrosamines in various vegetable oils and margarines in Germany, a study was carried out to determine nitrosamine levels in such products sold in retail outlets in Canada. 38 samples of various vegetable oils, 10 of butter, 14 of margarine, and 6 of lard were analysed. All the oils and lard were negative. Only one butter and 5 margarine samples contained trace levels (0.2–3.8 ng/g) of *N*-nitrosodimethylamine and/or *N*-nitrosomorpholine. Further investigations at the plant level failed to uncover any definite source of the nitrosamine contamination detected in some of the margarine samples. Recent samples of margarine from these plants were, however, either negative or contained insignificant levels of volatile nitrosamines. It was concluded that nitrosamine levels in these products are either negative or negligible and, therefore, should not be a matter of concern. AS

14

[Nitrosamines in the human environment. Determination of volatile *N*-nitrosamines in maize silage and milk with the nitramine-method and comparison of this method with determination by thermo-luminiscence.] Das Nitrosaminproblem in der menschlichen Umwelt. Bestimmung von flüchtigen *N*-Nitrosaminen in Maissilage und Milch mit der Nitramin-Methode und Vergleich mit der Thermolumniniscenz-Analyse.
Möhler, K.; El-Refai, E.-S. M.
Zeitschrift für Lebensmittel-Untersuchung und -Forschung 172 (6) 449–453 (1981) [10 ref. De, en] [Inst. für Ernährungswissenschaften, Lehrbereich Bromatologie an der Fak. für Landwirtschaft & Gartenbau der Tech. Univ. München, D-8050 Freising-Weihenstephan, Federal Republic of Germany]

In 3 seasons 1976–1979, nitrosamines were estimated in whole crop maize on several farms during and after ensiling. The IARC-nitramine method proved unsatisfactory for this purpose with recoveries of dimethyl-, diethyl-, dipropyl- and dibutyl-nitrosamines (NDMA, NDEA, NDPA and NDBA) 25, 55, 75 and 75%, resp.; thermal energy analysis [*IARC Scientific Publication* 9:40 (1975)] was therefore used. Of 180 samples 60% contained NDMA, NDEA, NDPA and/or NDBA and some other unidentified compounds; in most cases individual nitrosamines were <2 μg/kg but some samples contained NDMA at up to 85 μg/kg, and NDEA >100 μg/kg (max. 512). There was no correlation between nitrosamine formation and silage nitrate or nitrite content. In 1977/78 and 1978/79, nitrosamines were estimated by thermoluminescence analysis in milk from farms having silage with the highest nitrosamine content. In 1977/78 only 1 of 6 milk samples contained NDMA at >0.1 μg/kg (0.3 μg/kg). In 1978/79 only 2 of 43 samples contained NDMA >0.1 μg/kg (0.3 and 0.8 μg/kg). The highest concn. of nitrosamine NDEA, 3 μg/kg, was in milk from a farm on which silage contained NDEA 354 μg/kg; milk from the farm on which silage had NDEA 512 μg/kg contained no detectable nitrosamines. Recoveries of NDMA and NDPA from milk were 60 and 67%, resp. BWH

15

[Studies on the possibilities of *N*-nitrosamine synthesis in milk with the contribution of an *Escherichia coli* strain.]
Kisza, J.; Przybylowski, P.
Bulletin de l'Academie Polonaise des Sciences, Sciences Biologiques 28 (1/2) 7–16 (1980) [27 ref. En, ru] [Inst. of Food Engineering & Biotech., 10-957 Olsztyn-Kortowo, Poland]

Pasteurized skim milk, containing added $NaNO_3$ (0.05–0.20%) and/or dimethylamine (0.05%), was inoculated with *Escherichia coli* and incubated at 37°C for 72 h. The $NaNO_3$ added to milk was reduced by 14–19% in 8 h, by 61–67% in 12 h and by 82–95% in 24 h. At the same time there was an increase in the nitrite content of the milk up to 24 h, but none was detected in milk incubated for 48 or 72 h. From GLC and MS analyses, a compound with properties similar to those of *N*-nitrosamines was detected in milk samples containing added $NaNO_3$ and dimethylamine and inoculated with *E. coli*. The role of *E. coli* in formation of *N*-nitrosamines is discussed. MEG

16

[Nitrosamine trace analyses of anchovies and smoked fish.] Nitrosamin-Spurenanalysen von Anchosen und Räucherfischen.
Röper, H.; Heyns, K.; Günther, W.
Chemie Mikrobiologie Technologie der Lebensmittel 7 (1) 13–17 (1981) [11 ref. De, en] [Inst. für Organische Chemie & Biochemie, Univ. Hamburg, Martin-Luther-King Platz 6, D-6000 Hamburg 13, Federal Republic of Germany]

Anchovy-type products (herring, sprats), hot smoked fish (bloaters, mackerel, halibut, eel, sprats, 'Schillerlocken') and cold smoked fish ('Lachshering', salmon) were analysed for volatile nitrosamines by GLC and GLC/MS; the anchovy-type products were stored at 4°C for ≤4 months and analysed after 1, 4, 8 and 16 wk. Nitrosamines were not detected during the 4 months storage period. *N*-nitrosodimethylamine (NDMA) was detected and quantitively determined in some of the hot smoked fish, with NDMA contents as follows: bloaters, 1.4 parts/billion (p.p.b.); mackerel, 8.6 p.p.b.; halibut, 1.3 p.p.b.; and eel, 55.8 p.p.b. Cold smoked fish did not contain nitrosamines. The high NDMA content in smoked eel indicates the need for further study on the possible dependence of NDMA content on the smoking technique used. [From En summ.] RAW

17

[Determination of *N*-nitrosamines in meat products.]
Zur Bestimmung von *N*-Nitrosaminen in Fleischwaren.
Köhne, D.; Mirna, A.
Fleischwirtschaft **61** (1) 111–114 (1981) [8 ref. De, en] [Bundesanstalt für Fleischforschung, 8650 Kulmbach, Federal Republic of Germany]

Volatile *N*-nitrosamines (NA) were determined in meat products by a combination of GLC with a Thermal Energy Analyzer. Other nitroso compounds were determined by subsequent UV irradiation of sample extracts. Under the conditions used, the limit of detection was 0.5 μg NA/kg. Amounts in excess of this were found in cured meat products, with max. 12.0 μg/kg *N*-nitrosodimethylamine in raw ham, mean for 12 samples 7.6, range 2.0–12.0; 3.5 μg/kg in raw (dry) sausage, mean for 14 samples 2.0, range 0–3.5. No *N*-nitrosodiethylamine was found in any of the 39 samples examined; <0.5 μg/kg *N*-nitrosopiperidine in 3 samples and 0.7 μg/kg *N*-nitrosopyrrolidine in 2 samples, 0.6 in 1 sample and <0.5 in 4 samples of raw ham. RM

18

Precursors to nitrosopyrrolidine and nitrosopiperidine in black pepper treated with nitrous acid.
Nakamura, M.; Katoh, K.; Kawabata, T.
Agricultural and Biological Chemistry 45 (5) 1257–1259 (1981) [7 ref. En] [Dep. of Food & Drug Sci., Kanagawa Prefectural Public Health Lab., 52-2 Nakao-cho, Asahi-ku, Yokohama, 241, Japan]

Because of reports that black pepper used as a spice in sausages can react with nitrite to form nitrosopyrrolidine (NPYR) and nitrosopiperidine (NPIP), precursors for formation of NPYR and NPIP were sought in benzene extracts of black pepper. Benzene extracts were fractionated by TLC, and separate fractions were treated with $NaNO_2$ under acidic conditions. Precursors of the nitrosamines identified, and their levels in black pepper, were: piperine 4.6%, pyrroperine 0.1%, piperidine 18 p.p.m., and pyrrolidine 5 p.p.m. Yields of NPIP and NPYR from these compounds however account for only approx. 10% of total nitrosamine formation from benzene extracts, suggesting involvement of other compounds. DIH

19

[Symposium on nitrates, nitrites and *N*-nitroso compounds in foods.] [Conference proceedings] **France, Centre National de la Recherche Scientifique**
Annales de la Nutrition et de l'Alimentation **34** (5/6) 757–1088 (1980) [many ref. Fr, en]

The following papers were given at a symposium on nitrates, nitrites and nitroso-compounds in foods held in Dijon, France, on May 6 and 7, 1980. Toxicological and nutritional aspects of nitrates and nitrites, by G. de Saint-Blanquat (pp. 827–863). Detn. of nitrate accumulation in plant tissues, by Y. Coic & G. Lesaint (pp. 929–936). Effect of N fertilization and harvesting time on production and NO_3^--N in French bean pods, by J. Decau, A. Bouniols, B. Pujol & J. P. Rellier, pp. 947–954. Results of 5-yr trials on reduction of NO_3^- contents in carrot roots, by A. Auffray, Y. Celerier & J. Paufique, pp. 955–962. Study on NO_3 accumulation in carrot roots. Agronomic results, by D. Blanc, C. Otto & S. Mars, pp. 963–968. Changes in NO_3^- contents in drinking water in the Yonne departement; new results (1975–1979), by J. P. Voilliot, C. Mere & J. P. de Grimal, pp. 989–996. A further 19 papers are abstracted separately in FSTA, and can be found in the author index under **France, Centre National de la Recherche Scientifique [Nitrites/Nitrates Symposium].** RM

20

***N*-Nitrosospermidine: the principal nitrosation product of spermidine.**
Takeda, Y.; Kanaya, H.
Experientia **37** (9) 1007–1008 (1981) [9 ref. En] [Hatano Res. Inst., Food & Drug Safety Cent., Hadano, Kanagawa 257, Japan]

Spermidine was reacted with a limited amount of nitrite, as previous studies of nitrosation products of polyamines found in foods have used excess nitrite. 50mM spermidine was reacted with 65mM $NaNO_2$ at pH 3.5 and room temp. for 16 h. The major *N*-nitroso compound formed in the reaction (in an overall yield of 22.5%) was isolated by ion-exchange chromatography on SP-Sephadex and was identified to be *N*-nitrosospermidine [*N*-(4-aminobutyl)-*N*-(3-aminopropyl)nitrosamine]. After correction for unreacted spermidine, yield of this compound was 45%, so *N*-nitrosospermidine is a major product of the reaction. *N*-nitrosospermidine was not found to be significantly mutagenic in the *Salmonella typhimurium* assay using tester strains TA1535, TA1537, TA98 or TA100, with or without rat liver S9 mix. DIH

21

[Analysis of volatile nitrosamines in foods and beverages: validity of results.] [Lecture]
Klein, D.; Debry, G.
Annales de la Nutrition et de l'Alimentation **34** (5/6) 779–789 (1980) [many ref. Fr, en] [Univ. de Nancy I, 54000 Nancy, France]

Methods of analysis for volatile nitrosamines in foods and beverages are described. Possibilities of loss and formation of these compounds are discussed for each step, viz. transport and storage of samples, sample preparation, extraction of volatile nitrosamines (by solvent, digestion, distillation), concn. of extracts,

purification, and qualitative and quantitative detn. (liquid or GLC). The validity of GLC and HPLC detn. is evaluated for each type of detector, with special attention to the thermal energy analyzer (TEA detector). [See FSTA (1982) 14 3A149.] RM

22

[Formation and analysis of nitrosamines in foods – a brief review.] Bildung und Nachweis von Nitrosaminen in Lebensmitteln – ein kurzer Überblick.
Aitzelmüller, K.; Thiele, E.
Fette Seifen Anstrichmittel 83 (6) 222–226 (1981) [15 ref. De, en] [NATEC – Inst. für Naturwissenschaftlich-technische Dienste GmbH, Behringstrasse 154, D-2000 Hamburg 50, Federal Republic of Germany]

A brief review is presented to illustrate a number of current problems. Formation of nitrosamines in food products, analysis of volatile nitrosamines in the parts/billion range by the thermal energy analyser combined with GLC, and analysis of non-volatile nitrosamines are briefly discussed. AS

23

[Presence of volatile nitrosamines in foods.] [Lecture]
Klein, D.; Girard, A.-M.; Carbarrou, C.; Debry, G.
Annales de la Nutrition et de l'Alimentation 34 (5/6) 915–927 (1980) [many ref. Fr, en] [Univ. de Nancy 1, 40 rue Lionnois, 54000 Nancy, France]

122 samples of foods and 46 beers from various regions, especially from N. E. France, were analysed for volatile nitrosamines. Results tabulated showed that non-grilled cured meat products (ham) are only lightly contaminated: nitrosodimethylamine (NDMA) and nitrosopiperidine (NPi) concn. were usually <1 part/billion (p.p.b.). Only 2 out of 30 samples were contaminated by NPi (28.6 and 26 p.p.b.) and by nitrosopyrrolidone (Npy, 3 and 11 p.p.b.). The latter was only rarely identified in other samples, and only in trace amounts. Pre-cooked and canned meats and cheese products were rarely and only lightly contaminated (max. 1.6 p.p.b. NDMA, 2.7 Npy in a parsley cheese). Most of the beers were contaminated. NDMA was found in all the pale ales, at 0.1–21.3 p.p.b. (mean 3.11), and NPy at 0.2–0.3 p.p.b. In dark beers NDMA concn. were 7.2–16.8 p.p.b. (mean 10.1) and Npy 0.1–0.3 p.p.b. [From En summ.] [See FSTA (1982) 14 3A149.] RM

24

[*N*-nitroso compounds: occurrence and formation.] [Review]
Klein, D.; Debry, G.
Cahiers de Nutrition et de Dietetique 16 (2) 89–96, 101–108 (1981) [105 ref. Fr, en] [Dep. of Nutr. et des Maladies Metaboliques de l'Univ. de Nancy I, 40 Rue Lionnois, 54000 Nancy, France]

This detailed review includes tabulated data on: the type and concn. of (i) *N*-nitroso compounds found in a wide range of foods; effects of heating on (i) found in cooked bacon; (i) concn. found in various cheeses; (i) concn. found in beverages; and daily intake of (i) from various foods. Origins of precursors (particularly nitrites) and the (i) formation process in foods are also covered. HBr

25

[*N*-nitrososarcosine formation from precursors in the body.]
Zhukova, G. F.; Makeev, D. A.
Voprosy Pitaniya No. 1, 64–66 (1981) [11 ref. Ru, en] [Lab. Kantserogenov Inst. Pitaniya AMN SSSR, Moscow, USSR]

Method is described for the study of carcinogen *N*-nitrosarcosine (NS) formation in (i) aqueous solution, (ii) gastric juice of the dog and (iii) the rat stomach following peroral introduction of precursors (sarcosine and sodium nitrite). NS formation was max. at pH 3 and at 1:1 molar ratio of the precursors in (i) and (ii). In the study of possible endogenous formation of NS in (iii), introduction of 36 mg sarcosine + 30 mg sodium nitrite resulted in formation of 3–14 mg NS in 1½ h. It was concluded that NS formation was sufficiently high and could constitute a carcinogenic threat as a result of endogenous and exogenus NS formation from precursors present in foods. RAW

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[Role of nitrites and nitroso-compounds in abnormal cheese colouration. Decomposition studies.] [Lecture]
Huynh, C.-H.; Huynh, S.; Boivinet, P.
Annales de la Nutrition et de l'Alimentation 34 (5/6) 1069–1076 (1980) [11 ref. Fr, en] [Lab. de Microbiol., Fac. des Sci. de Marrakech, Marrakech, Morocco]

Pont l'Eveque cheese, manufactured by traditional procedures, turned pink in colour when KNO_2 was added at a rate of 1 kg/30 l milk before renneting. Sprinkling KNO_2 on the surface of the curd gave cheese with a brown colour, and injection of a nitrite solution into the curd resulted in distention, formation of a large number of cavities and a brown colouration of the cheese. Crystals of KNO_2 placed on the surface of normal Pont l'Eveque cheese during ripening also resulted in swelling and cavity formation. Addition of nitrate did not cause similar defects. The formation of nitroso-compounds was shown to be the cause of the red or brown colour in the cheese. The presence of *Debaryomyces ancenis* in the cheese milk reduced the colour formation. Enzymes present in the yeast were able to decompose the nitroso-compounds. [See FSTA (1982) 14 3A149.] MEG

27

[Formation of nitrosamines in cheeses.] [Lecture]
Klein, D.; Keshavarz, A.; Lafont, P.; Hardy, J.; Debry, G.
Annales de la Nutrition et de l'Alimentation 34 (5/6) 1077–1088 (1980) [many ref. Fr, en] [Dep. de Nutr. & des Maladies Metaboliques, Univ. de Nancy I, 54000 Nancy, France]

In studies with strains of *Penicillium caseicolum, P. roqueforti, P. candidum, P. camemberti* and *Mucor* spp. grown in a semi-synthetic medium enriched with 200 p.p.m. nitrate or nitrite and 100 p.p.m. piperidine, only small amounts of nitrite could be detected in the medium after incubation for 1 wk at 20°C. Strains used in cheesemaking did not produce nitrosopiperidine, whereas other strains produced 9–27 µg/kg in the medium containing nitrite; 147–221 µg/kg were formed in the uninoculated medium incubated under the same

conditions. Camembert cheese was manufactured from milk containing added $NaNO_3$ (200 p.p.m.) with or without addition of 100 p.p.m. piperidine. The amount of nitrosodimethylamine in the 2 types of cheeses increased resp. from 0.5 to 21 and from 3 to 16 µg/kg during ripening. [See FSTA (1979) 11 5C309 & (1982) 14 3A149.] MEG

28

[*N*-Nitrosamines in dairy products.]
Melamed, D. B.; Kostyukovskii, Ya. L.
Voprosy Pitaniya No. 4, 70–71 (1980) [6 ref. Ru] [Lab. Enzimologii Pitaniya, Inst. Pitaniya AMN SSR, Moscow, USSR]

Nitrosodimethylamine (NDMA), nitrosodiethylamine (NDEA) and and nitrosopiperidine were not detected in milk, Cottage cheese, cultured cream, butter, kefir and some cheese varieties. Cheddar and Camembert cheeses had NDMA at 0.9 to 7µg/kg. The NDMA and NDEA occurr ed in Novyi cheese, 1.0 to 2.9 and 1.0 to 2.5 µg/kg, resp. and in Roquefort cheese, 0.7 to 1.4 and 0.8 µg/kg, resp. The 3 nitrosamines were present in Swiss cheese. [From *Nutrition Abstracts and Reviews, 51 B,* 1538.]

29

Volatile nitrosamines in salt-preserved fish before and after cooking.
Huang, D. P.; Ho, J. H. C.
Food and Cosmetics Toxicology 19 (2) 167–171 (1981) [14 ref. En] [Med. & Health Dep., Inst. of Radiology & Oncology, Queen Elizabeth Hospital, Kowloon, Hong Kong]

Uncooked, steamed and fried samples of salted yellow croaker were analysed for volatile nitrosamines (*N*-nitrosodimethylamine (NDMA), *N*-nitrosodiethylamine (NDEA), *N*-nitrosodi-*n*-propylamine (NDPA), *N*-nitrosodi-*n*-butylamine (NDBA) and *N*-nitrosomorpholine (NMOR)) by GC with detection by chemiluminescence, and some were also analysed by combined GC and high-resolution MS. NDMA was detected in all the samples analysed, whether cooked or uncooked. It was also detected in the aqueous phases derived from the steamed samples and in the oil from frying in 2 out of 3 batches. NDEA was detected in more batches of steamed fish than of uncooked or fried fish. It was not detected in the oil used for frying. In half the steamed batches NDEA was detected only in the aqueous phases. NDPA was detected in both steamed and fried samples and NDBA in only fried samples. Neither was detected in uncooked samples. NMOR occurred in the uncooked samples. NDMA and NDEA occurred in both uncooked fish heads and in soups prepared from them. These results show that certain nitrosamines are formed from precursors during cooking. A possible relationship between salted fish and certain cancers that are particularly prevalent among southern Chinese populations is discussed. VJG

30

[The problem of additives in meat products: nitrites.]
Baldini, P.
Industria Conserve 56 (1) 26–32 (1981) [51 ref. It, en] [Sta. Sperimentale per l'Ind. delle Conserve Alimentari, Parma, Italy]

The conflicting demands of microbiological safety (especially with regard to *Clostridium botulinum*) and min. nitrosamine contents in meat products are reviewed. Effects of substrate (polarity, energy sources, catalysts, inhibitors, water activity, pH) and of processing techniques and storage conditions are discussed. RM

31

Anomalies in the mass spectrum of *N*-nitrosopyrrolidine.
Libbey, L. M.; Scanlan, R. A.
Journal of the Association of Official Analytical Chemists 64 (5) 1255–1256 (1981) [6 ref. En] [Dep. of Food Sci., Oregon State Univ., Corvallis, Oregon 97331, USA]

Several anomalies in the published standard mass spectrum of *N*-nitrosopyrrolidine (NPYR) were pointed out and a new standard spectrum was presented. It was suggested that the published standard was partially thermally degraded, perhaps by an overheated inlet line or interface to the mass spectrometer. Specific anomalies thought to be due to overheating included a marked decrease in the relative intensity of m/z 100 (M^+) and a concomitant increase in m/z 30 and m/z 69. The large ion at m/z 28 could not be attributed to overheating, nor to an air leak; rather it is part of the normal spectrum for NPYR. AS

32

Volatile *N*-nitrosamines in dried foods.
Sen, N. P.; Seaman, S.
Journal of the Association of Official Analytical Chemists 64 (5) 1238–1242 (1981) [8 ref. En] [Food Res. Div., Health & Welfare Canada, Ottawa, Canada K1A 0L2]

An investigation was carried out to determine the levels of volatile *N*-nitrosamines in several dried food commodities such as malt, instant skim milk powder, infant formula containing milk powder, instant coffee, soup and soup bases, and baby cereals. The method involves vacuum distillation of the sample from 3N KOH or 1% sulphamic acid, followed by extraction of the aqueous distillate with dichloromethane. The dichloromethane extract is then washed with an acidic buffer (to remove amines), dried over anhydrous sodium sulphate, concentrated in a Kuderna-Danish concentrator, and analysed by GLC, using a thermal energy analyser. Detection limit is 0.1–0.5 ng/g. Of the samples analysed thus far, all malts (22 samples) and instant skim milk powders (11 samples) were positive for *N*-nitrosodimethylamine (NDMA); average levels were 7.4 ng/g (1.3–67.0 ng/g) and 0.4 ng/g (0.3–0.7 ng/g), resp. Traces of NDMA and/or *N*-nitrosopyrrolidine were also detected in 3 of 20 dried soups and 5 of 10 instant coffees analysed. Traces of NDMA and/or *N*-nitrosopiperidine (NPIP) were detected in 3 of 8 powdered infant formulas. All 4 baby cereal samples were negative. The identity of NDMA in 14 samples of malt and that of NDMA and NPIP in an infant formula was confirmed by GLC-MS; identity of *N*-nitrosamines in 3 instant coffees and 1 infant formula was independently verified by HPLC analysis. AS

33

Toxicology and occupational medicine. [Conference proceedings]
United States of America, University of Miami School of Medicine
Developments in Toxicology and Environmental Science **4,** xiv + 480pp. ISBN 0-444-00288-X (1979) [many ref. En][Miami, Florida, USA]

Papers from this 10th Inter-American Conference, held at Miami, Florida on 22–25th Oct. 1978, include: Legal and scientific concerns re carcinogens in food, by A. C. Kolbye, Jr. (pp. 9–18). Toxicology and its role in regulatory practice, by R. W. Fogleman (pp. 19–23, 3 ref.). Mechanism of action of diet as a carcinogen, by J. H. Weisburger & H. F. Mower (pp. 109–128, 61 ref.). Plant tannins and esophageal cancer, by J. F. Morton (pp. 129–137, 30 ref.). The safety of food additives: the dynamics of the issue, by F. C. Lu (pp. 175–189, 4 ref.). Bracken fern (BF), a natural urinary bladder carcinogen, by G. T. Bryan & A. M. Pamukcu (pp. 229–232, 8 ref.). What causes ciguatera, by D. P. de Sylva (pp. 423–431, 42 ref.). Toxins in the ciguatera food chain, by D. P. de Sylva & W. B. Deichmann (pp. 433–440, 27 ref.). Progress in potable water – USA (1974–1978), by P. J. Schouboe (pp. 455–464, 16 ref.). LH

34

Analytical methodology for sample preparation, detection, quantitation, and confirmation of *N*-nitrosamines in foods. [Review]
Hotchkiss, J. H.
Journal of the Association of Official Analytical Chemists **64** (5) 1037–1054 (1981) [183 ref. En][Dep. of Food Sci., Cornell Univ., Ithaca, New York 14853, USA]

A selected review is given of recent approaches to each of the stages involved in analyses of foods for *N*-nitrosamines, viz. isolation from food, cleanup and concentration, separation, detection, quantitation and confirmation. TLC, GLC and HPLC separation methods are discussed, as are many detection systems, with particular emphasis on thermal energy analysis. Artifacts and collaborative studies are also discussed. In conclusion it is stated that only MS can be used for unequivocal confirmation of identity, which is possible at original concn. of < 1 μg/kg. and that current methods for nonvolatile nitrosamines are inadequate. DIH

35

[Nitrosamines in feed, milk and dairy products.]
Nitrosamine in Futter, Milch und Milchprodukten.
Terplan, G.; Bucsis, L.; Heerdegen, C.
Archiv für Lebensmittelhygiene **31** (1) 1–5 (1980) [many ref. De, en][Inst. für Hygiene & Tech. der Lebensmittel Tierischen Ursprungs, Munich, Federal Republic of Germany]

The transfer of nitrosamines from silage into milk, and their formation in processed cheese and cheese dishes from nitrite or nitrite-containing foods were studied. Their presence in cheese made with nitrate was reviewed from published data. No nitrosamine is formed in raw and heated milk. Addition of nitrate to cheese milk is reported to occasionally produce low concn. of nitrosamine in the cheese, but similar concn. have been reported for cheese made without nitrate. 2 of 12 samples of processed cheese contained nitrosamines, as well as 3 of 8 samples of processed cheese with ham, 1 of 5 samples of processed cheese with salami, 1 of 10 other processed cheese preparations and 2 of 3 samples of processed cheese with added nitrite. Formation of nitrosamines was prevented by additions of 10, 50 or 500 p.p.m. ascorbic acid. No nitrosamine was detected in dishes prepared from nitrite-containing meat and cheese (ham and cheese on toast). The occasional presence of nitrosamine in some dairy products thus presents a negligible health hazard, especially in view of the endogenous nitrite and nitrate formation. RM

36

An investigation into the formation of N-nitrosamines in heated chicken frankfurters.
Gray, J. I.; Bussey, D. M.; Dawson, L. E.; Price, J. F.; Stevenson, K. E.; Owens, J. L.; Robach, M. C.
Journal of Food Science **46** (6) 1817–1819 (1981) [En] [Dep. of Food Sci. & Human Nutr., Michigan State Univ., E. Lansing, Michigan 48824, USA]

Chicken frankfurters, prepared with various levels of sodium nitrite (0, 20, 40, 60, 100, and 156 p.p.m.) were heated either in a microwave oven, boiled or broiled and then analysed for *N*-nitrosamines. As expected, "apparent" *N*-nitrosamine levels increased with increasing concn. of sodium nitrite. The effect of the various heating procedures on *N*-nitrosamine formation was inconclusive, due possibly to the low levels of "apparent" *N*-nitrosamines present. The 2 most common *N*-nitrosamines present appeared to be *N*-nitrosodimethylamine and *N*-nitrosomorpholine. However, only in the frankfurter samples prepared with 156 p.p.m. nitrite was the presence of *N*-nitrosomorpholine confirmed by MS. IFT

37

Long-chain acetals of ascorbic and erythorbic acids as antinitrosamine agents for bacon.
Bharucha, K. R.; Cross, C. K.; Rubin, L. J.
Journal of Agricultural and Food Chemistry **28** (6) 1274–1281 (1980) [10 ref. En][Canada Packers Inc., Toronto, Ontario, Canada M6N 1K4]

In a previously published study [see FSTA **11** 9S1399], various compounds were synthesized and subsequently found to inhibit nitrosamine formation in bacon. This paper continued this study by examining one such class of compounds, viz. hitherto unknown long-chain acetals of ascorbic acid (AA) and erythorbic acid (EA). The bacon used in the study was commercial pump-cured side bacon (150 p.p.m. $NaNO_2$). Ascorbyl pivalate and ascorbyl acetonide were applied to bacon slices in water solution because of their poor oil solubility. The acetonide was also applied as a slurry in soybean oil. Ascorbyl palmitate and the acetals were applied as a slurry in antioxidant-free soybean oil (usually 4 ml/lb). The bacon was either fried

immediately or vacuum-sealed in packages for storage at 3°C. Studies conducted on the bacon included: effect of storage time on anti-nitrosamine activity (ANA) of ascorbyl palmitate; influence of length of acetal side-chain on ANA; influence of sodium erythorbate on ANA of the C acetal of AA, effect of storage time on the ANA of acetals of hexadecanal with AA and EA at 1000 p.p.m.; effect of C16 acetal of AA on nitrosamine formation in bacon under household frying conditions; effect of adding acetal to the frying pan before the bacon on the nitrosamine level in fried bacon; and comparison of the effect of smoking and not smoking on nitrosamine levels in fried bacon. Results are detailed in tables and discussed. Conclusions included the following: ascorbyl palmitate is far more effective (70–90% inhibition at the 500–1000 p.p.m. level) than sodium ascorbate or erythorbate in reducing nitrosamine formation in bacon but its activity decreases with storage time; long-chain acetals of AA result in 93–98% reduction of nitrosamines in cook-out fat when streaked on bacon slices at 1000 p.p.m. C16 ascorbyl acetal (250 p.p.m.) either with or without sodium erythorbate (550 p.p.m.) gives 80–90% reduction of nitrosamine formation in cook-out fat; under household frying conditions, C16 ascorbyl acetal-treated bacon gives <1 part/billion nitrosamines; mode of application of acetal is not critical; C16 acetals of both AA and EA retain their activities (>90% inhibition of nitrosamines) for ≥35 days at 3°C when applied at the 100 p.p.m. level; smoking has little if any effect on nitrosamine levels in cooked bacon. JA

38

[Nitrate, nitrite and nitrosamines in food.]
[Conference proceedings]
Sweden, SIK – Svenska Livsmedelsinstitutet
SIK Rapport No. 485, 150pp. (1980) [Sv, En, Da, No]
[Fack, S-400 23 Göteborg, Sweden]

This publication comprises papers presented at this symposium, held at SIK on 6–7 May 1980, including the following. Nitrates, nitrites and nitrosamines in foods, by J. Kahl (4pp., Sv). Analysis of nitrate and nitrite in foods, by B. Hedlund (9pp., Sv). Analysis of N-nitroso compounds in foods, by E. Josefsson (9pp., 9 ref., Sv). Occurrence of nitrate/nitrite in vegetables, by T. Nilsson (12pp., 8 ref., Sv). Summarizing report of the working party for study of occurrence of nitrosamines, by C.-E. Borström (26pp.; 345 ref., Sv). Occurrence of nitrate and nitrite in dairy products, by B. Lindqvist (12pp., Sv). Occurrence of nitrate and nitrite in fish, by B. G. Snygg (9pp., Sv). Volatile N-nitroso compounds in foods in Sweden, by E. Josefsson & S. Nygren (22pp., 16 ref., Sv). Bacteriological aspects of the use of nitrite in meat products and alternatives for nitrite, by P. S. van Roon (13pp., 40 ref., En). Nitrate, nitrite and nitrosamines in foods. Improved process hygiene as an alternative to nitrite, by N. Skovgaard (22pp., 37 ref., Da). Colour of meat products, theory and possibilities for influencing it, by E. Slinde (10pp., No). Norwegian experience with prohibition of nitrites, by H. K. Dahle (2 pp., No). AJDW

39

[Method for determining *N*-nitrosoproline in food products.]
Kann, Yu. M.; Tauts, O. V.; Lettner, A. Kh.
Voprosy Pitaniya No. 5, 65–67 (1981) [10 ref. Ru, en]
[Kafedra Tekh. Pishchevykh Produktov Tallinskogo Politekh. Inst., Tallin, Estonian SSR]

A gas chromatographic method for detn. of *N*-nitrosoproline (NNP) in foods involves extraction with an acetone/water mixture (7:3), 3-step purification (extraction) of the extract at different pH, evaporation to dryness, and methylation with diazomethane; NNP methyl ether is subsequently determined using a PYE-104 gas chromograph with the TEA-502 thermal energy analyser. NNP yield is 43.3 ± 3.4%, and method sensitivity 5 µg/kg. RAW

40

Formation of *N*-nitrosoproline by reacting nitrite with L-citrulline and L-arginine.
Ishibashi, T.; Kawabata, T.
Journal of Agricultural and Food Chemistry 29 (5) 1098–1099 (1981) [8 ref. En] [Res. Lab., Japan Med. Foods Ass., Higashikurume, Tokyo 180-03, Japan]

Formation of *N*-nitrosoproline (NPro) from food components in simulated human stomach conditions was studied. $NaNO_2$ (0.3M) was reacted with 0.03M L-citrulline or L-arginine. NPro was identified as a reaction product by GLC and GLC-MS of its methyl ester. Yield of NPro was 0.1% from arginine and 27.1% from citrulline. Citrulline, which is present in water melons, soy sauce and peppers, may be an important precursor for potential NPro formation in the human stomach. DIH

41

[Mutagenic activity of and nitroso compounds in meat and vegetable extracts.]
Porrini, M.; Testolin, G.; Cantoni, C.; Renon, P.
Industrie Alimentari 20 (3) 174–176 (1981) [12 ref. It, en] [Istituto di Ispezione degli Alimenti di Origine Anim., Univ. degli Studi, Milan, Italy]

Experiments to ascertain presence of nitroso compounds in meat and bouillon cubes were carried out on 4 samples of meat and 3 of vegetable extracts. The method of Mirna et al. [see FSTA (1973) 5 11S 1328] was used to determine nitrates (absent in 5 samples, 19 and 27 mg/kg in the other 2) and nitrites (ranges, 318–421 mg/kg in the meat; 151–450 mg/kg in the vegetable extracts). *N*-nitrosamines were extracted, followed by analysis by either (i) spectrophotometry or (ii) gas chromatography. As (i) gave N-nitrosamine concn. 2–3 × greater than (ii), 2 hypotheses are propounded in explanation, viz. the irradiation necessary in (i) may form reaction compounds which increase the absorbency, or the solvent (aqueous dichloromethane) used for (ii) may only partially extract the *N*-nitrosamines. Nitrosodimethylamine was detected in all samples (meat, 110, 70, 53 and 90 parts/billion (p.p.b.); vegetable extracts, 110 and 140 p.p.b.); traces of nitrosodiethylamine were found in only 1 sample. It is concluded that nitrates may induce mutagenic activity by their transformation to nitrosamines. KME

42

Determination and confirmation of *N*-nitrosodimethylamine in beer.
Andrzejewski, D.; Havery, D. C.; Fazio, T.
Journal of the Association of Official Analytical Chemists 64 (6) 1457–1461 (1981) [10 ref. En] [Div. of Chem. & Physics, FDA, Washington, DC 20204, USA]

A qualitative method was developed for confirmation of *N*-nitrosodimethylamine (NDMA) in beer by capillary GLC/MS from full mass scans after quantitation, using a gas chromatograph interfaced to a thermal energy analyser (GLC/TA). The GLC/MS method has a lower limit of confirmation of 5 µg/l. In a survey of 22 imported and 42 domestic beers, NDMA was found in 60 samples by GLC/TA at levels up to 7.7 µg/l, and was confirmed by GLC/MS in 5 samples. AS

43

Report of the technical subcommittee on *N*-nitrosamines in malt and beer. [Lecture]
Marinelli, L. (Chairman)
Journal of the American Society of Brewing Chemists 38 (3) 111–113 (1980) [3 ref. En]

4 methods, 2 each for malt and beer, for the detn. of *N*-nitrosodimethylamine (NDMA) were evaluated as a preliminary to full-scale study of the available methods. The testing involved either direct extraction of the beer or a malt/water slurry, or extraction of a distillate from these materials, with dichloromethane, followed by gas chromatographic detn. of the NDMA. Variations tested included the addition of sulphamic acid to prevent nitrosation, and the use of an internal standard. Using the same calculation methods, no statistically significant difference could be demonstrated between the direct and the distillation procedures for beer. Use of an internal standard gave consistently higher average results, but the differences were not statistically significant. [See FSTA (1982) 14 5H699.] JRR

44

Model system studies on N-nitrosamine formation in cured meats: the effect of curing solution ingredients.
Theiler, R. F.; Sato, K.; Aspelund, T. G.; Miller, A. F.
Journal of Food Science 46 (4) 996–998 (1981) [3 ref. En] [Food Chem. Dep., Armour Res. Cent., 15101 N. Scottsdale Road, Scottsdale, Arizona 85260, USA]

Solutes commonly employed in curing solutions were evaluated for their effect on nitrosamine formation, utilizing a ground pork model system. Sodium erythorbate and sodium ascorbate were found to be equally effective in reducing nitrosopyrrolidine levels. The incorporation of sodium tripolyphosphate or sucrose had no detectable effect on nitrosamine formation. However, NaCl, the solute present at the highest concn. in bacon curing solutions, exhibited a concn. dependent inhibition of nitrosopyrrolidine formation. Nitrosopyrrolidine levels in samples containing no added NaCl were found to be 50% higher than in samples processed with 1.5% added salt. IFT

45

Nitrosamine precursors in the adipose tissue of pork bellies.
Spinelli-Gugger, A. M.; Lakritz, L.; Wasserman, A. E.; Gates, R. A.
Journal of Food Science 46 (4) 1136–1138, 1151 (1981) [18 ref. En] [USDA E. Reg. Res. Cent., SEA-AR, 600 E. Mermaid Lane, Philadelphia, Pennsylvania 19118, USA]

Adipose tissue has been implicated as the primary site of nitrosopyrrolidine (NPYR) production in fried bacon. In a study on the precursors of NPYR, pork belly adipose tissue was extracted with trichloromethane/methanol and yielded an organic layer, an aqueous polar fraction, and a tissue residue. Fractions were heated with nitrite, and the polar fraction accounted for most of the nitrosamines in intact adipose tissue. Fractionation of the polar fraction yielded an eluate that was collected in 7 aliquots. All aliquots formed N-nitrosodimethylamine when heated with nitrite, but the bulk of NPYR was formed from an eluate corresponding to the first of 3 UV absorbent bands at 254 nm. IFT

46

[Nitrate, nitrite and nitrosamines – consumption and health hazards.]
Slorach, S. A.
Var Föda 33 (8/9) 324–334 (1981) [11 ref. Sv] [Toxikologiska Lab., Statens Livsmedelsverk, 751 26 Uppsala, Sweden]

Aspects discussed include: sources of nitrate and nitrate in the diet (natural sources and use as additives); intake of nitrate and nitrate in the diet; formation of nitrite and nitrate in the body; toxicity of nitrates and nitrites, and the health hazard therefrom; minimization of risks; *N*-nitroso compounds and their sources (including cured meat products and beer); formation in the body; carcinogenicity, and minimization of health hazards. AJDW

47

Nitrate, nitrite, and volatile nitrosamines in pickled fish prepared with addition of nitrate.
Pedersen, E.; Meyland, I.
Zeitschrift für Lebensmittel-Untersuchung und -Forschung 173 (5) 359–361 (1981) [5 ref. En, de] [Nat. Food Inst., Morkhoj Bygade 19, DK-2860 Soborg, Denmark]

Samples of pickled herrings, and of pickled herring titbits and sprats (all obtained from retailers in Copenhagen) were analysed for nitrate and nitrite by a colorimetric method and for 7 nitrosamines by gas chromatography on a 10% Carbowax 20M column after isolation by a mineral oil distillation technique (MS was not used for confirmation). 12 samples of pickled herrings sold in jars contained nitrate in the range not detected–170 mg/kg (contents similar in fish and brine). 6 products did not declare nitrate as an additive and contained ≤ 10 mg/kg; the remainder contained > 57 mg/kg and nitrate use was declared in all but 1. Nitrite was detected in only 1 sample at 2 mg/kg (nitrate content 64 mg/kg). All samples

containing >57 mg nitrate/kg contained nitrosodimethylamine at trace to 0.8 µg/kg; no nitrosamines were detected in the low nitrate samples. Nitrate contents in 9 samples of canned titbits and sprats ranged from not detected to 565 mg/kg; nitrite was detected in only 2 of the 9 samples, both at 2 mg/kg (no apparent correlation with nitrate levels); and 8 of the 9 samples contained nitrosodimethylamine at trace to 2.2 µg/kg (no apparent relation between nitrosamine content and nitrate level). DIH

48

Effect of belly composition on sorbate-cured bacon.
Amundson, C. M.; Sebranek, J. G.; Rust, R. E.; Kraft, A. A.; Wagner, M. K.; Robach, M. C.
Journal of Food Science 47 (1) 218–221 (1982) [En] [Dep. of Anim. Sci., 215 Meat Lab., Iowa State Univ., Ames, Iowa 50011, USA]

A comparison was made between fat-type and lean-type bellies cured with either 40 p.p.m. sodium nitrite/0.26% potassium sorbate or 120 p.p.m. sodium nitrite. Residual nitrite levels were higher in fat bacon regardless of cure. Sorbate-cured bacon resulted in significantly higher thiobarbituric acid numbers than did regular-cure bacon. Nitrosopigment:total pigment ratio did not vary with cure, but did remain significantly higher in fat bacon and roughly paralleled residual nitrite levels. Analysis for nitrosamines indicated greater concn. in fat bellies compared to lean. Nitrosamines were suppressed though not eliminated, by the sorbate cure in both fat and lean bellies. IFT

49

Effect of belly handling (chilled, frozen, pre-rigor) and smoking delay on regular and sorbate cured bacon.
Amundson, C. M.; Sebranek, J. G.; Kraft, A. A.; Rust, R. E.; Wagner, M. K.; Robach, M. C.
Journal of Food Science 47 (1) 222–225 (1982) [En] [Dep. of Anim. Sci., 215 Meat Lab., Iowa State Univ., Ames, Iowa 50011, USA]

Bellies from 3 handling methods; fresh, frozen, or prerigor were cured with either 40 p.p.m. sodium nitrite/0.26% potassium sorbate or 120 p.p.m. sodium nitrite. After pumping, one group of bellies was processed (cooked and smoked) immediately, and the remaining group was held 72 h before processing. Residual nitrite was significantly higher in regular cure bacon and in bellies processed immediately. By 28 days after packaging, little difference was seen in residual nitrite as a result of any treatment. Regular bacon and immediate processing resulted in greater nitrosopigment conversion. Prerigor bacon had greater pigment conversion and greater residual NaCl concn. while fresh and frozen bellies were similar. Nitrosamine levels were not influenced by belly handling variables. IFT

50

The nitrite-cancer controversy.
Carr, C. J.
Regulatory Toxicology and Pharmacology 1 (1) 68–77 (1981) [12 ref. En] [Food Safety Council, 1725 K Street, NW, Suite 306, Washington, DC 20006, USA]

This report was prepared to illustrate the work of the Scientific Committee of the Food Safety Council on the nitrite-cancer controversy. Headings surveyed are: background, evidence of nitrite-nitrate hazard, FDA actions, UAREP (Universities Associated for Research and Education in Pathology) contributions, test evaluations, different interpretations of pathology findings, conclusions of the interagency working group, other nitrite animal studies, present status of the controversy, the Food Safety Council report, and the safety decision tree (8 decision steps involved). LH

51

An analysis of weak mutagens in the Ames assay.
Katz, M.; Kazmer, S.; Weinstein, D.
Journal of Environmental Pathology and Toxicology 3 (5/6) 171–187 (1980) [8 ref. En] [Dep. of Exp. Path., Hoffmann-La Roche Inc., Nutley, New Jersey, USA]

Nitrosopiperidine, $NaNO_2$ and 1,2-epoxybutane were tested in the Ames agar incorporation assay in an attempt to establish exact criteria for detecting the activity of these weak mutagens. As regards min. concn. it was determined that at 500 µg/plate a statistical analysis and several concn. of the activating system are required in order to manifest an indication of the mutagenicity of 1,2-epoxybutane. The mutagenicity of $NaNO_2$ was detectable at 80 µg/plate while nitrosopiperidine produced a 2.5–3.2 increase over background at 250 µg/plate. It is concluded that since weak mutagenicity cannot be predicted it is advisable to utilize the max. concn. possible within the limits of solubility and bacterial toxicity. At the higher concn., 1,2-epoxybutane, nitrosopiperidine and $NaNO_2$ produced revertant colony counts equal to 7, 17 and 62 times above background, resp. AS

52

[Role of nutritional factors on the biological action of xenobiotics.] [Review]
Sharmanov, T. Sh.
Voprosy Pitaniya No. 5, 51–57 (1981) [33 ref. Ru, en] [Kazakhskii Filial Inst. Pitaniya AMN SSR, Alma-Ata, USSR]

In this review the author discussed his own work and literature covering animal trials on the effect of dietary protein on the uptake and elimination of pesticides, nitrosamines and aflatoxins. The role of food processing to reduce nitrosamine contents is briefly considered, with tabulated data on the occurrence and level of nitrosamine contamination in various foods, e.g. wheat flour, fresh milk, meat and fish. RAW

53

[Possible endogenous synthesis of dimethylnitrosamine in rats fed dimethylamine and nitrite.]

Rubenchik, B. L.; Romanenko, A. M.; Gulich, M. P.; Karpilovskaya, E. D.; Pliss, M. B.; Zakharenko, L. N.; Gorban', G. P.

Voprosy Pitaniya No. 3, 50–54 (1980) [12 ref. Ru, en] [Kievskii Inst. Gigieny Pitaniya Min. Zdravookhraneniya UkSSR, Kiev, USSR]

Rats fed diets containing (i) dimethylamine [DMA] and sodium nitrite, developed cancerous and other lesions similar to those observed in rats fed diets containing dimethylnitrosamine. Incorporation of ascorbic acid into diet (i) reduced the occurrence of such lesions. RAW

54

Report of the ASBC subcommittee on *N*-nitrosamines in malt and beer for 1979–1980. II.

Marinelli, L. **(United States of America,** American Society of Brewing Chemists) (Chairman)

Journal of the American Society of Brewing Chemists 39 (1) 35–38 (1981) [4 ref. En]

A supplementary report, completing the presentation of results of a collaborative study of methods for the analysis of *N*-nitrosodimethylamine in malt and beer, is presented. The results for the beer study have previously been reported, and are again summarized [see FSTA (1982) 14 5H814]. In the case of malt, the basic methods tested, i.e. dichloromethane extraction of an aqueous extract of ground malt, or vacuum distillation of a ground malt/water slurry followed by extraction of the distillate, gave significantly different results for one pair of samples, but not for another pair. Neither malt method gave consistently better precision. The results from a calculation method employing an internal standard were significantly different from, and higher than, a method using an external standard curve. It is recommended that the collaborative study be repeated for both malt and beer methods, that a third method be incorporated in the study, and that emphasis be placed on decreasing the detection limits of the methods. [See FSTA (1982) 14 5H699.] JRR

55

Control of *N*-nitrosodimethylamine in malt through the use of liquid/gaseous sulfur dioxide.

O'Brien, T. J.; Lukes, B. K.; Scanlan, R. A.

Technical Quarterly, Master Brewers' Association of the Americas 17 (4) 196–200 (1980) [5 ref. En, es] [Great Western Malting Co., Vancouver, Washington, USA]

The burning of S in the malt kiln has proven to be effective for control of *N*-nitrosodimethylamine (NDMA) in the manufacture of barley malt. NDMA formation can be controlled by burning elemental S if the S is applied continuously at a prescribed rate during the first hours of drying. Air currents passing over the surface of burning S affect combustion so that accurate control of application is very difficult. Since SO_2 is the major product of combustion of elemental S, direct injection of liquid/gaseous SO_2 offers the same benefits as burning S with the added advantage of precision control. Installation of a SO_2 injection system including storage, evaporators, flow meters, recorders, and low level alarms has enabled accurate control of SO_2 application. Treating the malt when it is most receptive to SO_2, through a staggered rate of application to whole malt produced in 1, 2, and 3 deck kilns has resulted in NDMA levels from non-detectable to 5 µg/kg. AS

56

Technical report of the USBA Ad Hoc Committee on Nitrosamines.

Hardwick, W. A.; Ladish, W. J.; Meilgaard, M. C.; Jangaard, N. O.

Technical Quarterly, Master Brewers' Association of the Americas 18 (2) 92–108 (1981) [En, es]

A report is presented of the work done for the United States Brewers Association under the supervision of several committees, dealing with the technical aspects of *N*-nitrosodimethylamine formation in malt. The papers making up the report are abstracted separately in the following 3 abstr. JRR

57

Introduction to the technical report on nitrosamines.

Hickman, D. H.

Technical Quarterly, Master Brewers' Association of the Americas 18 (2) 93–94 (1981) [5 ref. En, es]

The historical circumstances leading to the formation of the Ad Hoc Committee on Nitrosamines, whose report is here presented, are briefly surveyed, with reference to the data which originally prompted concern about the nitrosamine content of malt and beer. [See preceding abstr.] JRR

58

The determination of NDMA in beer and in brewing materials.

Hardwick, W. A.

Technical Quarterly, Master Brewers' Association of the Americas 18 (2) 95–96 (1981) [3 ref. En]

The methods employed in detn. of *N*-nitrosodimethylamine for the preparation of the report here presented are explained. All detn. consisted of extraction by organic solvent, followed by gas chromatographic isolation and detection and quantification by thermal energy analyser. Topics discussed include the precision and repeatability of the methods, the special problems associated with the detn. of nitrosamines in malt, and the evidence which has been found to suggest that malt is the sole source of *N*-nitrosodimethylamine in the brewing process. [See preceding 2 abstr.] JRR

59

Studies on grains and the malting process.

Ladish, W. J.

Technical Quarterly, Master Brewers' Association of the Americas 18 (2) 96–108 (1981) [57 ref. En]

The experimental work of the Ad Hoc Committee on Nitrosamines is reported. Topics discussed include the effects of different concn. of N oxides in the gases during kilning on the *N*-nitrosodimethylamine (NDMA) content of malt; the theoretical chemical mechanisms for nitrosation; the non-effect of herbicide application

on subsequent NDMA formation during kilning; the identification of NDMA precursors in malting barley, and the steps taken to minimize NDMA formation, including the operation of low NO kilns, and indirect firing of kilns. [See preceding 3 abstr.] JRR

60

Inhibition of N-nitrosamine formation by soya products.

Kurechi, T.; Kikugawa, K.; Fukuda, S.; Hasunuma, M.

Food and Cosmetics Toxicology 19 (4) 425–428 (1981) [19 ref. En] [Tokyo College of Pharmacy, 1432-1, Horinouchi, Hachioji, Tokyo 192-03, Japan]

Soy products such as tofu (soybean curd), soy milk, miso (soybean paste) and Bonlact (powdered soy milk with additives) are very common foods commercially available in Japan. Effects of these products on nitrite concn. and on formation of N-nitrosamines in vitro were investigated. All of them effectively decreased nitrite levels at pH 3 and 4, the effect being greater at pH 3. They inhibited formation of N-nitrosodimethylamine and N-nitrosodiethylamine from sodium nitrite and the appropriate dialkylamine at gastric pH. For example, 20% (w/v) tofu, 60% (v/v) soy milk, 10% (w/v) miso and 4% (w/v) Bonlact inhibited by 46, 51, 74 and 44%, resp., formation of N-nitrosodimethylamine from 0.2M-nitrite and 0.05M-dimethylamine at pH 3 and 37°C for 3 h. Loss of nitrite and inhibition of N-nitrosamine formation by soy products may be attributed to lipids or minor phenolics contained in the products. AS

61

[N-nitroso compounds in foods from regions with increased stomach cancer morbidity.]

Arkhipov, G. N.; Zhukova, G. F.; Livergand, M. I.; Bombir, S. A.; Zinov'ev, O. S.; Kozenko, A. N.; Litvinova, V. T.; Sumacheva, L. P.

Voprosy Pitaniya No. 3, 61–63 (1981) [8 ref. Ru] [Inst. Pitaniya AMN SSSR, Moscow, USSR]

Local foods from areas showing, according to USSR statistics, increased stomach cancer morbidity were analysed for contents of *N*-nitrosodimethylamine (NDMA), *N*-nitrosodiethylamine, *N*-nitrosodipropylamine, *N*-nitrosopiperidine, and *N*-nitrosopyrrolidine using a fluorescent technique for volatile nitrosamines. Values (mg/kg) are tabulatd for 3–10 samples of smetana (only traces of NDMA found), tvorog (only traces of NDMA) potatoes, sauerkraut, cooking salt, salted lard, salt beef, and various salted or dried fungi. *N*-nitrosamines were detected in most foods analysed, pickled, salted and dried products in particular; none were detected in potatoes or milk. SKK

62

Rapid dry column method for determination of *N*-nitrosopyrrolidine in fried bacon.

Pensabene, J. W.; Miller, A. J.; Greenfield, E. L.; Fiddler, W.

Journal of the Association of Official Analytical Chemists 65 (1) 151–156 (1982) [9 ref. En] [USDA, Philadelphia, Pennsylvania 19118, USA]

A rapid method was developed for the detn. of *N*-nitrosopyrrolidine (NPYR) in fried bacon at less than the 1 p.p.b. level. Ground fried bacon is mixed with anhydrous Na_2SO_4 and Celite by using a glass mortar and pestle. This dry mixture is then added to a chromatographic column containing a layer of acid-Celite. The column is washed with pentane-dichloromethane, and the nitrosamines are eluted with pure dichloromethane. The eluate is concentrated, and the nitrosamines are quantitated by using a gas chromatograph interfaced with a thermal energy analyzer. Recovery of the nitrosamine internal standard *N*-nitrosoazetidine, added at the 10 p.p.b. level, was over 90%. The results obtained by this method are in good agreement with the mineral oil distillation procedure currently used in the FSIS monitoring program. Because 25 samples can be analysed/day per person, this simple screening procedure offers advantages over other methods. AS

63

Analysis of a model ionic nitrosamine by microbore high-performance liquid chromatography using a thermal energy analyser chemiluminescence detector.

Massey, R. C.; Crews, C.; McWeeny, D. J.; Knowles, M. E.

Journal of Chromatography 236 (2) 527–529 (1982) [11 ref. En] [Food Lab., Min. of Agric. Fisheries & Food, Haldin House, Queen Street, Norwich NR2 4SX, UK]

Analysis of trace levels of volatile nitrosamines in foods has been greatly facilitated by development of the nitrosamine-specific thermal energy analyser chromatographic detector (TEA) which however, has been limited largely to GLC detn. of volatile nitrosamines due to constraints on the choice of HPLC solvent systems e.g. inorganic buffers and ion-pair reagents cannot be used with the pyrolyser and only trace levels of water can be used in the mobile phases. Analysis of ionic nitrosamines (zwitterions, quaternary N compounds and macromolecular peptides) has not been reported. This difficulty may be overcome by use of microbore HPLC, and to assess the possibilities a model ionic nitrosamine (*N*-nitroso *N*, *N*-dimethylpiperazinium iodiole) was synthesized. This was analysed by HPLC-TEA using reversed-phase ion pair conditions with a Chrompack microbore ODS column and 0.1M ammonium heptane-sulphonate in methanol/water (70:30) as mobile phase. The ionic nitrosamine eluted as a sharp symmetrical peak and the highly polar mobile phase had little effect on TEA signal stability because of the low flow-rate. This illustrates the potential of this technique for food analysis. ELC

64

The role of phenols in catalysis of nitrosamine formation.

Walker, E. A.; Pignatelli, B.; Friesen, M.

Journal of the Science of Food and Agriculture 33 (1) 81–88 (1982) [16 ref. En] [Int. Agency for Res. on Cancer, 150, Cours Albert-Thomas-69372, Lyon Cedex 2, France]

Phenolic compounds which can potentially form C-nitroso derivatives by reaction with nitrite can act as catalysts on the formation of an *N*-nitrosamine from nitrite and a secondary amine. Using a gas chromatographic technique, this effect was measured for di- and trihydric phenols and for a number of naturally occurring phenolic compounds in the case of *N*-nitrosodiethylamine (NDEA) formation. The kinetics for this catalytic effect were studied in detail with dinitrosoresorcinol and two possible mechanisms were suggested. In addition, it was shown that a number of naturally occurring phenols catalyse the formation of NDEA under alkaline conditions and such catalysis can lead to the artifactual formation of nitrosamines during their analysis. AS

65

[Degradation of *N*-nitrosamines by bacteria.]
Cattaneo, P.; Cantoni, C.; Bersani, C.
Industrie Alimentari 20 (5) 376–378 (1981) [8 ref. It] [Istituto di Ispezione degli Alimenti di Origine Animale, Univ. degli Studi di Milano, Milan, Italy]

Based on the principle that nitrosamine degraded by bacteria will liberate nitrite which may then be measured by colorimetry (Griess reaction), a study of the action of 11 bacterial strains on diphenyl- (DPNA) and dimethylnitrosamine (DMNA) was undertaken as part of research aimed at finding natural protective factors. (i) 3 lactobacilli (Streptobacteria), (ii) 3 clostridia *(Clostridium perfringens)*, (iii) 3 *Escherichia coli* and (iv) 2 *Fusiformis fragilis*, incubated to the semi-exponential phase, were treated with solutions of DPNA and DMNA and examined by colorimetry after 24 h. Results for DPNA (tabulated) showed 22.2–50.2% degradation by (i), 3.7–6.2% by (ii), and $<1\%$ by (iii) and (iv). DMNA was not degraded by any of the bacterial strains under the experimental conditions used. It was considered that the results confirmed the view that DPNA, by reason of its likely degradation, is not carcinogenic. KME

66

Effects of nitrosamines, nitrite and secondary amines on tumor development in mice. [Lecture]
Pearson, A. M.; Sleight, S. D.; Cornforth, D. P.; Akoso, B. T.
Proceedings of the European Meeting of Meat Research Workers No. 26, Vol. II, M-2, pp. 216–218 (1980) [5 ref. En] [Michigan State Univ., E. Lansing, Michigan 48824, USA]

Trials were conducted with mice receiving (i) control tap water, (ii) water containing *N*-nitrosopyrrolidone at 100 mg/l; (iii) water containing 1 g $NaNO_2$/l, or (iv) water with 100 mg $NaNO_2$/l + 100 mg pyrrolidine/l, for 12 months. 10 mice received each treatment. The study was replicated 4 times. Data are given for feed and water consumption, survival and incidence of cancers. Survival ranged from 94.4% for (i) to 80.5% for (ii), differences approached significance. Group (ii) had a much higher incidence of tumours of the lungs and liver than the other groups; incidence of tumours did not differ significantly between (i), (iii) and (iv). The results are considered in relation to the lack of carcinogenicity of diet (iv) (nitrite + secondary amine) and its implications for the postulated nitrosation of amines in the stomach. [See FSTA (1982) 14 8S1379.] AJDW

67

[Formation of nitrosamines.]
Schmidt-Hebbel, H.
Alimentos 5 (2) 36–38 (1980) [9 ref. Es] [Dep. de Quimica y Tecnologia de Alimentos, Univ. de Chile, Santiago, Chile]

Aspects discussed include: toxicity of nitrites; nitrosamines in foods; formation of nitrosamines in the alimentary tract; carcinogenicity of nitrosamines; effects of pH, temp. etc. on nitrosamine formation; inhibitory and catalytic action; use of nitrites as a curing agent in meat products; nitrite in relation to control of *Clostridium botulinum;* analysis of nitrosamines; and limitation of levels of nitrite used in curing of meat products. AJDW

68

Removal of nitrosamines from beverages.
Pollock, J. R. A. (Pollock & Pool Ltd.)
UK Patent Application 2 071 692A (1981) [En]

Process is described for reducing the nitrosamine content of a beverage, e.g. whisky or other alcoholic beverage. After preparing the beverage but before final packaging for sale, the beverage is illuminated with visible light and subsequently stored in the dark at from -5 to 30°C, for (preferably) ≥ 3 days. The process does not usually adversely affect the beverage flavour. [From En summ.] RAW

69

A process for preparing malt.
Aalbers, V. J. (Heineken Technisch Beheer BV)
UK Patent Application 2 073 242A (1981) [En]

It has been found that the formation of nitrosamines, usually occurring during malting when kilning germinated barley, can be suppressed even in the absence of sulphur dioxide by treating the germinated barley with an aqueous solution or dispersion of saccharides before it is kilned. The saccharides are present at 0.1–1% by dry wt. of barley; the saccharide may be starch hydrolysate, glucose, fructose, saccharose, a trisaccharide, or a dextrin. [From En summ.] RAW

70

[Nitrosamines in beer and whisky.]
Klein, D.
Medecine et Nutrition 17 (4) 293–300, 303 (1981) [23 ref. Fr, en] [Dep. de Nutr. & des Maladies Metaboliques, Univ. de Nancy I, 5400 Nancy, France]

After a discussion of the toxicity and carcinogenicity of nitrosamines, their analysis, and literature data for their concn. in alcoholic beverages, experimental data are given for nitrosamine concn. in French beers. Of 36 samples of pale beers analysed, all contained nitrosodimethylamine at concn. of 0.1–21.3 parts/billion (ppb, mean 3.11 ppb); 2 contained nitrosopyrrolidine, at 0.2 and 0.3 ppb. Of 10 samples of dark beers, all contained nitrosodimethylamine at concn. of 4.0–17 ppb (mean 9.5 ppb); 9 contained nitrosopyrrolidine at 0.1–0.3 ppb (mean 0.2 ppb). Whisky has only low nitrosamine concn., comparable to those in other spirits. There seems to be a trend towards decreased nitrosamine levels in beer. AJDW

71

[Contents of N-nitrosamines in fish and some types of fish preserves.]
Dikun, P. P.; Romanova, L. E.; Shendrikova, I. A.; Reim, N. D.; Yunusova, Z. Yu.
Rybnoe Khozyaistvo No. 8, 69–73 (1980) [1 ref. Ru] [NII Onkologii im. Prof. N. N. Petrova, USSR]

Content of nitrosamines in smoked fish in oil and in frozen and smoked fish (sprats, cod) was studied; the total content of nitrosamines was determined colorimetrically, and individual nitrosamines were determined by gas chromatography. Frozen fish contained mainly dimethyl nitrosamine and diethyl nitrosamine. Colorimetric studies revealed some other nitrosamines. The contents of nitrosamines depend on fish type and degree of decomposition of the original nitrosamines, which is affected by the oil used; thus the total of nitrosamines in preserved products may be lower vs. that in the raw material. STI

72

Microbial degradation of nitrosamines. II. Effect of the conditions of growth and enzymic reaction on the nitrosamine breakdown.
Harada, K.
Bulletin of the Japanese Society of Scientific Fisheries [Nihon Suisan Gakkai-shi] 46 (6) 723–726 (1980) [3 ref. En] [Lab. of Biochem., Dep. of Food Sci. & Tech., Shimonoseki Univ. of Fisheries, Shimonoseki 759-65, Japan]

The effect of growth conditions of *Rhizopus oryzae* and enzymic reaction conditions in the cell-free extract on the degradation of nitrosodimethylamine (NDMA) and nitrosodipropylamine (NDPA) was investigated. Of the growth conditions, degradation activities in growing cells were highest when the strains incubated for 1 day were inoculated into potato-malt medium of pH 8.0 containing either NDMA or NDPA. Optimal temp. and nitrosamine concn. for the NDMA and NDPA degradation were different. No marked difference was found in the activities of stationary and shaking cultures. The cell-free extract of 3 and 4 days growing-cells which were precultured under optimal conditions were maximally active in degrading NDPA and NDMA resp. Of the enzymic reaction conditions, degradation activities in the cell-free extract were highest at 30°C and pH 8.0 under anerobic conditions. Nitrosamine degradation exhibited a concn. dependence different from the relation found in the growth conditions, viz. degradation activities were high in concn. > 0.1 mM. [See FSTA (1980) 12 6R384 for part I.] AS

73

Nitrosamines in irradiated bacon. [Lecture]
Fiddler, W.; Gates, R. A.; Pensabene, J. W.; Wierbicki, E.
Proceedings of the European Meeting of Meat Research Workers No. 26, Vol. I, E-19, pp. 237–240 (1980) [14 ref. En] [USDA, E. Reg. Res. Cent., Philadelphia, Pennsylvania 19118, USA]

Pork bellies were cured to give $NaNO_2$ concn. of 0, 20 or 120 p.p.m., smoked, sliced, packed in metal cans, γ-irradiated at −40°C with a dose of 3.0 Mrad, and subsequently analysed for residual nitrite; nitrosamines were determined in fried samples. Irradiation reduced the residual nitrite concn., and hence reduced levels of nitrosodimethylamine and nitrosopyrrolidone in the fried bacon. Levels of nitrosamines in samples cured with 20 p.p.m. nitrite were indistinguishable from those in the nitrite-free product. [See FSTA (1982) 14 8S1379.] AJDW

74

The effect of oxygen on nitrosamine formation in bacon.
Dennis, M. J.; Massey, R. C.; McWeeny, D. J.
Zeitschrift für Lebensmittel-Untersuchung und -Forschung 174 (2) 114–116 (1982) [8 ref. En, de] [Food Lab., Min. of Agric., Fisheries & Food, Haldin House, Queen Street, Norwich NR2 4SX, UK]

Bacon was cooked in a round-bottom flask or fried in oil in a pan, in both cases in enclosed conditions, either under air or N_2. Cooking vapour was trapped, condensed and analysed for *N*-nitrosodimethylamine (NDMA) and *N*-nitrosopyrrolidine (NPYR). In air, 4.1–32.7 μg NDMA and 4.1–69.7 μg NPYR/kg uncooked bacon were recovered from the cooking vapour. Under N_2, average inhibition of NDMA formation was 61.0%, that of NPYR was 59.6% (pan-frying experiments). In the flask experiments, formation of NDMA and NPYR was inhibited by N_2 by 50–92% in both cases. Possible role of nitric oxide in nitrosation reactions in frying bacon is discussed, in the light of this demonstration that the majority of nitrosamine formation during cooking of bacon takes place under O_2-dependent conditions. DIH

75

Nitrosamine analysis and inhibition studies. [Lecture]
Bailey, M. E.; Mandagere, A. K.
Proceedings of the European Meeting of Meat Research Workers No. 26, Vol. II, M-8, pp. 237–240 (1980) [11 ref. en] [Univ. of Missouri, Columbia, Missouri, USA]

Studies on inhibition of formation of *N*-nitrosopyrrolidine in model systems and in bacon are described. Dextrose, sodium ascorbate, dihydroxyacetone, pyruvaldehyde, and propyl gallate + L-cysteine considerably inhibited nitrosamine formation in model solutions; NaCl had little effect. Less nitrosamine was formed at pH 7.5 than pH 5.5. Nitrosamine formation was little affected by heating for 15 min vs. 30 min at 180°C. Studies on bacon gave similar results; propyl gallate + cysteine was the most efficient factor inhibiting nitrosamine formation, but gave unacceptable discoloration. GLC methods for analysis for nitrosamines are compared. [See FSTA (1982) 14 8S1379.] AJDW

76

Long-chain acetals of ascorbic and erythorbic acid as antinitrosamine agents for bacon. [Lecture]
Bharucha, K. R.; Cross, C. K.; Rubin, L. J.
Proceedings of the European Meeting of Meat Research Workers No. 26, Vol. II, M-1, pp. 212–215 (1980) [6 ref. En] [Canada Packers Inc., Toronto, Canada, M6N 1K4]

Studies were conducted to evaluate the potential of C12–C18 acetals of ascorbic and erythorbic acids for control of nitrosamine formation in bacon. Batches of bacon cured with 150 p.p.m. $NaNO_2$ were used. The acetals were applied to the bacon as slurries in soybean oil. Antinitrosamine activity of ascorbyl palmitate was also evaluated. Ascorbyl palmitate was far more effective (70–90% inhibition when applied at 500–1000 p.p.m.) than ascorbic or erythorbic acids; however, its activity decreased during storage. 1000 p.p.m. ascorbic acid long-chain acetal gave a 93–98% reduction in nitrosamine formation, chain length having little effect on antinitrosamine activity. The C12 acetal, and to a lesser extent the C14 acetal, give a soapy taste; higher acetals had no effect on organoleptic properties. Use of the acetals reduced nitrosamine concn. to <1 part/billion under household frying conditions. Addition of the acetals to oil used for cooking bacon gave similar results to addition to the bacon itself. Antinitrosamine activity was retained for ≥ 35 days for treated bacon stored at 3°C. Reduction of nitrosamine formation is greater for nitrosopyrrolidine than for nitrosodimethylamine. [See FSTA (1982) 14 8S1379.] AJDW

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The effects of ascorbic acid and sorbic acid on *N*-nitrosamine formation in a heterogeneous model system.

Massey, R. C.; Forsythe, L.; McWeeny, D. J.

Journal of the Science of Food and Agriculture 33 (3) 294–298 (1982) [14 ref. En] [Food Lab., Min. of Agric. Fisheries & Food, Haldin House, Queen Street, Norwich NR2 4SX, UK]

Effects of competitive nitrosation by ascorbic acid and sorbic acid on *N*-nitrosamine formation were studied in a heterogeneous protein-based model system containing a 20% non-aqueous phase. The reactions were examined at 37°C with an aqueous phase pH of 5.25. Under certain conditions ascorbic acid enhanced the nitrosation of secondary amines. The overall extent to which ascorbic acid affected *N*-nitrosation was found to depend on the time-scale of the reaction and also the phase in which *N*-nitrosamine formation occurred. Sorbic acid reduced *N*-nitrosation in both phases of the heterogeneous system. AS

78

[*N*-nitrosamines in beer and several non-alcoholic beverages.]

Zhukova, G. F.; Somina, S. I.; Ipatova, G. P.; Medvedev, F. A.; Bershova, T. M.

Voprosy Pitaniya No. 1, 48–50 (1982) [8 ref. Ru, en] [Inst. Pitaniya AMN SSSR, Moscow, USSR]

N-nitrosamines [NN] content was determined in 11 bottled beers (light and dark; domestically produced and imported), 3 Kvass wort concentrates, 'Russkii Kvas' bottled kvass, smoke-dried pear and 'Grushevyi' beverage made from the smoke-dried pear. Sample preparation (using an N-nitrosodipropylamine internal standard) and NN separation techniques are described, NN contents being determined by a fluorescence method and an MS-TLC method.

N-nitrosodimethylamine [NNDA] was the only nitrosamine detected in the samples, and then only in insignificant quantities (tabulated): NNDA was either absent or present in trace amounts up to 0.8 µg/l (in a beer sample). NN contents in domestically produced beers are claimed to be lower than in imported beers. Although NN were not detected in the dried pear, the possible occurrence of NN in fruits treated by this smoking treatment cannot be ignored, and further trials on this aspect are considered necessary. RAW

79

[Investigations on formation and occurrence of volatile nitrosamines in Danish cheese.]

Undersogelser over dannelse og forekomst af flygtige nitrosaminer i dansk ost. [Book]

Denmark, Proteinkemisk Institut; **Denmark,** Statens Forsogsmejeri; **Denmark,** Statens Levnedsmiddelinstitut

71pp. ISBN 87-503-3255-4 (1980) [41 ref. Da] Horsholm, Denmark [Venlighedsvej 4, DK 2970 Horsholm, Denmark]

Variations in normal techniques of manufacture, including the addition of nitrate, and storage had no effect on the content of volatile nitrosamines in Danish cheeses. 119 of 156 Danish cheese samples contained no detectable volatile nitrosamines, 34 contained traces (0.1–0.3 µg/kg) and only 3 contained more (0.6–0.7 µg/kg). Similar results were obtained for 19 samples of imported cheeses, with 8 free from nitrosamines, 7 containing traces, 3 containing 0.6–1.0 µg/kg and 1 (Parmesan) containing 3.6 µg/kg. [Also published in En, ISBN 87-503-3257-0.] ADL

80

[Determination of dimethylamine in shrimps bleached with sulphite, and formation of nitrosodimethylamine in the presence of nitrite.]

Yoshida, A.

Proceedings of Osaka Prefectural Institute of Public Health, Food Sanitation [Osaka-furitsu Koshu Eisei kenkyusho Kenkyu Hokoku, Shokuhin Eisei Hen] 12, 113–117 (1981) [11 ref. Ja]

Trimethylamine oxide (TMO) in homogenized shrimps was reduced with $TiCl_3$ and dimethylamine (DMA) was nitrosated with 50% $NaNO_2$. Trimethylamine and nitrosodimethylamine (NDMA) were extracted in dichloromethane and estimated by GLC with flame ionization detection. The amount of TMO in shrimps soaked in water or 1% or 5% Na_2SO_3 for 10 min was about 600 p.p.m. vs. 800 p.p.m. in shrimps soaked in 3% Na_2SO_3. Shrimps soaked in water or 1, 3 or 5% Na_2SO_3 contained DMA at 1.8, 6, 10 and 34 p.p.m. resp. When shrimps soaked in water or 1 or 5% Na_2SO_3 were incubated with 0.15% $NaNO_2$ for 2 h at pH 3.4 and 37°C final content of NDMA averaged 22.0, 28.4 and 83.2 µg/kg resp.; corresponding figures for shrimps incubated with 1.5% $NaNO_2$ were 184, 231 and 691 µg/kg. CIH

81

Volatile *N*-nitrosamines in meat products.

Kühne, D.; Mirna, A.

Fleischerei 32 (11) 890–892, 895, III, IV (1981) [En, De] [Bundesanstalt für Fleischforschung, E.-C.-Baumann-Strasse, D-8650 Kulmbach, Federal Republic of Germany]

Aspects considered include: nitrosamines in the environment and in non-food products; analytical techniques; nitrite concn. in relation to nitrosamine formation; additives (ascorbates, tocopherol) inhibiting nitrosamine formation; nitrosamine levels occurring in meat products; and legal limits. AJDW

82

A rapid liquid-liquid extraction cleanup method for the determination of volatile *N*-nitrosamines in cooked-out bacon fat.

Sen, N. P.; Seaman, S. S.

Journal of Agricultural and Food Chemistry 30 (2) 364–367 (1982) [16 ref. En] [Food Res. Div., Food Directorate, Health Protection Branch, Ottawa, Ontario, Canada K1A 0L2]

A rapid liquid-liquid extraction method is described for detn. of volatile nitrosamines in cooked-out bacon fat. The method consists of partitioning of the nitrosamines between *n*-hexane and an acidic aqueous-methanol mixture containing small amounts of sulphamic acid. An aliquot of the aqueous phase is then extracted with dichloromethane, the dichloromethane extract concentrated, and an aliquot of the concentrated extract analysed by a GLC-thermal energy analyser. Average % recoveries of *N*-nitrosodimethylamine, *N*-nitrosodiethylamine, *N*-nitrosopiperidine, *N*-nitrosopyrrolidine, and *N*-nitrosomorpholine when added to cooked-out bacon fat or lard at levels ranging between 5 and 20 ng/g were 78.8, 77.8, 89.4, 100.3, and 97.4, resp. The method has an overall detection limit of 1 ng/g for each of the above nitrosamines. Average levels (uncorrected) of *N*-nitrosodimethylamine and *N*-nitrosopyrrolidine detected in the 11 samples of cooked-out bacon fat were 4.8 and 21.1 ng/g, resp. AS

83

Method for high-performance liquid chromatographic measurement of N-nitrosamines in food and beverages.

Massey, R. C.; Crews, C.; McWeeny, D. J.

Journal of Chromatography 241 (2) 423–427 (1982) [10 ref. En] [Min. of Agric., Fisheries & Food, Food Sci Lab., Queen Street, Norwich NR2 4SX, UK]

A procedure for analysis of foods and beverages for N-nitrosamines is described in which liquid food or food extract samples are extracted using 'Preptubes' (Thermo-Electron Corp., Waltham, Massachusetts, USA), and the resulting extracts are analysed by HPLC on a Spherisorb 5 silica column (mobile phase hexane/ethanol/acetic acid, programmes 98:1:1 to 89:10:1, for acidic extracts, or acetone/hexane, programmed 2:98 to 98:2, for neutral extracts). A TEA model 502 chemiluminescence detector is used. Recovery was 76% for *N*-nitrosoproline added to meat (detection limit 5 µg/kg), and 91% for *N*-nitrosoproline added to beer (detection limit 1 µg/kg). Examples are given of chromatograms of beers analysed by this method. AJDW

82

N-nitrosamines in food.

Weston, R. J.

Food Technologist 12 (1) 13–16 (1982) [6 ref. En] [Chem. Div., Dep. of Sci. & Ind. Res., Petone, New Zealand]

An overview of N-nitrosamines in food, especially in New Zealand, is given, under headings of: formation, toxicity, occurrence and formation in foods (nitrite and nitrate, amines), origin of nitrosamines in foods (beer and whisky, fish, cheese, cured meat), analysis of nitrosamines (extraction, cleanup, concn., identification and detn.), New Zealand food, and risk assessment. LH

83

[Detection of *N*-nitrosamines in human blood and in foods.]

Matsumoto, H.; Kashimoto, T.; Kunita, N.

Proceedings of Osaka Prefectural Institute of Public Health, Food Sanitation [Osaka-furitsu Koshu Eisei kenkyusho Kenkyu Hokoku, Shokuhin Eisei Hen] 10, 121–126 (1979) [16 ref. Ja]

Nitrosodimethylamine estimated by GLC in ham (9 samples), sausage, (9), bacon (6), hamburger (4), beer (5) and sake (5) ranged from 0 to 178, 0–31.9, 0–3.5, 0–0.7, 0–3.7, and 0–2.4 parts/thousand million resp. None was found in roast pork (3) or whisky (4); 1 out of 4 samples of cod roe had 2 × 1 and 1 of 4 samples of corned beef had 32 parts/thousand million. Small amounts of nitrosodiethylamine, nitrosopiperidine and nitrosopyrrolidine were found in some samples. CIH

84

[The problems of *N*-nitrosamines – their formation and properties.]

Kellner, V.; Culik, J.; Basarova, O.

Kvasny Prumysl 28 (1) 7–11 (1982) [92 ref. Cs, ru, en, de] [Vyzkumny Ustav Pivovarsky a Sladarsky, Prague, Czechoslovakia]

The present research into the problems of nitrosamines in foodstuffs involves the occurrence, causes of their formation, detn. of their concn. and investigation of methods of either complete elimination of nitrosamines and their compounds or possibly their reduction to a min. The problems of the environment are discussed, with the effect of pH, catalysts and inhibiting substances. Physical properties and chemical properties as well as biological effects of the most common *N*-nitrosamines are given. The danger of carcinogenic risks for man are also dealt with. STI

85

[Determination of dimethylnitrosamine in beer and malt by differential pulse polarography.]

Pecenka, V.; Sagner, Z.; Mejstrik, V.

Kvasny Prumysl 28 (3) 53–59 (1982) [10 ref. Cs, ru, en, de] [Vyzkumny Ustav Organickych Syntez, Pardubice-Rybitvi, Czechoslovakia]

A new method for detn. of trace amounts of dimethylnitrosamine in beer and malt is based on isolation of the compound from the sample into a small vol. of dilute H_2SO_4, where qualitative assay is effected by photochemical decay, and quantitative detn. by differential pulsed polarography. The reliability of the method proved to be good, as shown by analyses of 8 samples of 12° light beer, 2 samples of 18° dark beer, 1 sample of non-alcoholic beer, and [illegible] samples

Reproducibility was about 8%, and limits of detection 0.1–0.6 µg/l and 0.6 µg/kg for beer and malt resp. The method, which does not require special apparatus, is applicable to many substrates. STI

86

[Effects of KNO_3 on formation of *N*-nitrosamines and on the microbiological quality of salami. Detection and determination of nitrosamines by gas chromatography-mass spectrometry.]
Lintas, C.; Ibba, P.; Siena, E. de; Massi, O.; Boniforti, L.
Rivista della Societa Italiana di Scienza dell'Alimentazione 10 (4) 217–220 (1981) [19 ref. It, en] [Istituto Nazionale delle Nutr., Via Ardeatina 546, Rome, Italy]

A modification of the GLC-MS method of Stephany et al. [in Analysis of volatile nitrosamines in foods, *IARC Scientific Publication* No. 18, (1978)] is described, based on homogenization of the sample with NaCl + water, steam distillation, solvent extraction with dichloromethane, concn. of the extract by evaporation, clean-up on an alumina column (elution with dichloromethane), gas chromatographic separation on a FFAP-coated capillary column, and MS analysis. Trials on spiked samples showed good separation of nitrosamines; recovery was approx. 70% and detection limit approx. 1 µg/kg. This method was applied to analysis of batches of salami made with 0, 0.062, 0.125 or 0.250 g KNO_3/kg, and matured for up to 60 days. No nitrosamines were detected in any sample. Organoleptic properties of all batches were normal, except that the highest $NaNO_3$ level gave slightly darker colour and softer consistency. AJDW

87

Trace analysis of *N*-nitrosoamines by HRGC.
Hesso, A.; Komi, M.-L.; Pyysalo, H.; Schimberg, R.; Sunila, P.; Wickström, K.
Kemia-Kemi 8 (12) 814 (1981) [En] [Inst. of Occupational Health, Haartmaninkatu 1, SF-00290 Helsinki 29, Finland]

In this work an automated method has been developed for quantitation of trace amounts of the most common *N*-nitrosamines by high resolution gas chromatography. Identification is based on use of programmed temp.-multidetector retention indices on 2 stationary phases of different polarity and use of N-sensitive detector. In the analysis the data system calculates retention indices, compares the obtained values with the reference data, and reports the identification and amounts of compounds found in the sample. The method is tested for the analysis of *N*-nitrosamines in foods and air samples. Results are compared with the data obtained by mass spectrometry with selective ion monitoring. [This is an abstract of a paper presented at a Symposium on High Resolution Chromatography, held in Espoo, Finland, on Nov. 20, 1981.] AS

88

Rapid determination of volatile *N*-nitrosamines in nonfat dry milk.
Havery, D. C.; Hotchkiss, J. H.; Fazio, T.
Journal of Dairy Science 65 (2) 182–185 (1982) [13 ref. En] [FDA, Washington, DC 20204, USA]

Dried skim milk and Celite are mixed, and ammonium sulphamate/H_2SO_4 solution is added. The mixture is added to a chromatographic column (32 mm internal diam. × 400 mm) containing 20 g anhydrous Na_2SO_4 and tamped in small increments to a total bed depth of 16–20 cm. The beaker containing the skim milk/Celite mixture is rinsed with 125 ml dichloromethane which is poured onto the column. The eluate is conc. to about 1 ml, and nitrosamines are separated on a gas chromatographic column packed with 10% Carbowax 1540 + 5% KOH on 100–200 mesh Chromosorb WHP and coupled to a thermal energy analyser. Nitrosamines are identified by comparison of retention times with those of reference standards. Mean recovery of nitrosodimethylamine added to dried skim milk at 3 ng/g was 96% (11 detn.). In a nationwide survey in the USA of dried skim milk, nitrosodimethylamine was found in 48 of 57 samples at 0.1–3.7 ng/g (mean 0.6 ng/g); nitrosopyrrolidine and nitrosopiperidine averaged approx. 0.1 ng/g, the detection limit of the method. DMK

89

Process for preparing cooked bacon having reduced levels of N-nitrosamines.
Theiler, R. F. (Armour & Co.)
United States Patent 4 315 015 (1982) [En]

Process is described for preparing cured bacon which, when cooked for consumption, contains substantially reduced levels of *N*-nitrosamines. The process comprises the steps of preparing a nitrite-stable injectable curing solution containing a nitrite, a liquid smoke and a reducing sugar, injecting the curing solution into a green belly, and processing the belly to effect curing. AS

90

[Carcinogenic *N*-nitroso-compounds – effects, formation, determination. Proceedings of the 3rd symposium.] Kantserogennye N-nitrozosoedineniya – deistvie, obrazovanie, opredelenie. Materialy III sympoziuma. [Book]
Loogna, G. O. (Editor)
215pp. (1978) [Ru] Tallin, USSR; Institut Eksperimental'noi i Klinicheskoi Meditsiny MZ Estonskoi SSR. Price 1.0r

This publication contains 119 papers from the symposium, grouped under the following headings: general problems (4 papers); carcinogenic effects of nitroso compounds, their precursors and degradation products (13 papers); modifying factors (16 papers); effect on embryonic tissues (14 papers); mode of action (15 papers); morphological and functional changes in carcinogenesis due to nitroso compounds (25 papers); formation, degradation and metabolism (11 papers);

nitroso compounds in foods and the environment – methods of detection (21 papers). Papers relevant to food products are: Comparative study of the toxic and blastogenic action of *N*-nitrosamines and their degradation products [in connection with chlorination and ozonization to decontaminate water containing typical precursors of *N*-nitrosamines, *N*-nitrosodimethylamine and *N*-nitrosodiethylamine], by N. Ya. Mikhailovskii, A. P. Il'nitskii, A. A. Korolev & E. V. Zaitseva (pp. 24–26). On the possible effect of increased nitrites content [e.g. in drinking water] on incidence of diseases of the digestive organs, and preventive measures, by S. K. Nuryagdyev, A. I. Aronskii & N. P. Makeeva (pp. 26–27). Study of the effect of carcinogenic nitrosamines and possible nitrosation products of secondary amines on the mussels *Unio pictorum*, by O. A. Sirenko (pp. 30–32). Microbial producers of nitrosodimethylamine from raw material used for bakery products, by Ya. A. Uibu & P. A. Bogovskii (pp. 167–168). Nitrates and nitrites in milk of cows fed on pasture under long-term cultivations, by R. M. Abdullina (pp. 172–173). GLC and fluorescence method for analysis of *N*-nitroso compounds in food products, by G. N. Arkhipov, G. F. Zhukova, V. V. Pimenova, V. S. Baeva, F. A. Medvedev & A. V. Krokhin (pp. 173–175). On establishing a hygienic standard for nitrite as a precursor of nitrosamines, by L. Ya. Vasyukovich & G. N. Krasovskii (pp. 175–176). Gas chromatographic analysis of volatile nitrogenous compounds in cooked beef, possible precursors of *N*-nitrosamines, by R. V. Golovnya, I. L. Zhuravleva & Yu. P. Kapustin (pp. 179–180). [Continued in following abstr.] RAW

91

[Carcinogenic *N*-nitroso-compounds – effects, formation, determination. Proceedings of the 3rd symposium.] Kantserogennye N-nitrozosoedineniya – deistvie, obrazovanie, opredelenie. Materialy III sympoziuma. [Book]
Loogna, G. O. (Editor)
215pp. (1978) [Ru] Tallin, USSR; Institut Eksperimental'noi i Klinicheskoi Meditsiny MZ Estonskoi SSR. Price 1.0r

[Continued from preceding abstr.] Use of ultrafiltration membranes for removal of *N*-nitroso compounds from food products, by G. F. Zhukova & V. V. Pimenova (pp. 184–185). Establishing permissible concentrations of nitrosodiethylamine and nitrates in an aqueous medium [e.g. water], by A. P. Il'nitskii, N. L. Vlasenko, T. Kh. Basieva, R. F. Belokon', N. Ya. Mikhailovskii, V. M. Voronin & A. A. Korolev (pp. 187–189). Concentrations of precursors of nitrosamines in the water of several reservoirs in North Estonia in 1974–1976, by A. R. Itra (pp. 189–191). Chromatographic methods for quantitative determination of volatile nitrosamines in aqueous media [e.g. river water and yeast hydrolysis waste water], by L. D. Kostenko, V. G. Kostenko & P. P. Dikun (p. 192). *N*-nitrosamines in domestically-produced food products, by Ya. L. Kostyukovskii & D. B. Melamed (pp. 193–194). Fluorescent, MS and chromatographic-MS methods for determination of *N*-nitrosamines in food products, by D. B. Melamed, Ya. L. Kostyukovskii & F. A. Medvedev (pp. 196–198). Determination of *N*-nitrosamines in cheese, by O. V. Tauts & U. O. Loigom (pp. 199–200). Determination of aflatoxions in various foods and feedstuffs, by R. E. Treimann (pp. 200–202) RAW

92

Malt beverages and brewing materials: screening and confirmatory methods for nitrosamines in beer.
Cutaia, A. J.
Journal of the Association of Official Analytical Chemists 65 (3) 584–587 (1982) [En] [Stroh Brewing Co., 1 Stroh Drive, Detroit, Michigan 48226, USA]

Screening methods for nitrosamines in beer were studied by 15 collaborators. Collaborators studied 4 extraction techniques and 2 calculation procedures. All methods showed acceptable recoveries and no significant differences between methods. Based on accuracy, simplicity and speed, the Celite extraction with internal standard calculation is recommended. 15 collaborators also studied a distillation confirmatory method compared with a direct extraction with dichloromethane. Because the former gives an extract more suitable for mass spectrometric confirmation of nitrosamines, it is the recommended reference method. The screening and confirmatory methods have been adopted official first action. AS

93

Gas-liquid chromatographic-thermal energy analyzer determination of *N*-nitrosodimethylamine in beer: collaborative study.
Sen, N. P.; Seaman, S.; Bickis, M.
Journal of the Association of Official Analytical Chemists 65 (3) 720–729 (1982) [12 ref. En] [Health Protection Branch, Health & Welfare Canada, Ottawa, Ontario, Canada K1A 0L2]

The GLC/TEA method for *N*-nitrosodimethylamine (NDMA) in beer was studied collaboratively by 13 laboratories from 7 countries. Collaborators were asked to analyse a total of 10 randomly labelled samples of beer consisting of the following duplicates: a naturally contaminated commercial beer; a beer extremely low (approx. 0.1 parts/billion, p.p.b.) in NDMA; and the low NDMA beer spiked with 0.5, 1.9, and 5.0 p.p.b. NDMA. The pooled repeatability and reproducibility coeff. of variation (CV) for all samples were 17% and 27%, resp. However, when data from 2 laboratories (outliers) were omitted, the corresponding CV values improved considerably (11% and 15%, resp.). Variance analysis showed the presence of a significant laboratory-sample interaction when all data were used for analysis, but this interaction disappeared when data from the 2 outlying laboratories were excluded. The pooled % recovery of the overall method (omitting outliers) was 101.4 ± 3.5. All the laboratories detected NDMA in the low NDMA beer. The method was adopted official first action. AS

94

N-nitrosodimethylamine in domestic beer in China.
Yin, F.; Ding, J. H.; Liu, S. L.
Food and Chemical Toxicology 20 (2) 213–214 (1982) [5 ref. En] [Dep. of Chem., China Univ. of Sci. & Tech., Hefei, Anhui, China]

26 samples of 11 different brands of bottled beer, collected in 4 Chinese cities (Beijing, Changchun, Jitin and Siping), were analysed for *N*-nitrosamines using gas chromatography-high resolution MS with a peak matching technique. Of the 26 samples, 20 (77%) were found to contain *N*-nitrosodimethylamine (NDMA), the mean content in these samples being 2.7 µg/l. The highest content of NDMA was found in the dark beer, the concn. in the 2 samples of this type analysed being 6.5 and 6.0 µg/l. The remaining 6 samples contained no detectable amounts of NDMA, indicating a content, if any, below 0.5 µg/l. The average recovery of NDMA added to beer was 74% with a coeff. of variance of 18%. It appears that the formation of NDMA is due mainly to the roasting of the green malt (usually heated with the smoke from burning coal) in which case the elimination of nitrosamine contamination from beer is possible and relatively simple. VJG

95

Process for preparing cooked bacon having reduced levels of N-nitrosamines.
Sleeth, R. B.; Theiler, R. F.; Rendek, R. B. (Armour & Co.)
United States Patent 4 315 948 (1982) [En]

Process is described for preparing bacon and, more particularly, for preparing bacon which, when cooked, will have reduced levels of *N*-nitrosamines. Green bacon bellies are injected with a curing solution composed of a nitrite-containing pickle, a liquid smoke and a food grade emulsifier. AS

96

[Investigation into the possibility of reducing the contents of nitrites in sausages and ground meat preserves.]
Dordevic, V.; Bokulic, S.; Pintaric, V.; Pospisil, A.; Hak, D.
Tehnologija Mesa 21 (11) 316–319 (1980) [5 ref. Sh, en] [Jugoslovenski Inst. za Tehnologiju Mesa, Belgrade, Yugoslavia]

It was established that addition of ascorbic acid reduced the contents of nitrosamines in sausages by 50% in samples containing 10 and 30% fat, and by a factor of >4 in samples containing 40% fat. Use of 5 mg% nitrites plus 0.05% ascorbic acid is recommended. STI

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